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INVENTORY MANAGEMENT OF SHIPBOARD
MATERIAL

by

Ralph H. Vogel

Thesis
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INVENTORY MANAGEMENT OF SHIPBOARD MATERIAL

By

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Bachelor of Science

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PREFACE

In this paper the problem within the Navy of optimizing shipboard supporting material through improved inventory management techniques is discussed. The optimization referred to is the ability of shipboard material inventories to support a Navy ship for long periods of time and away from all sources of supply. These inventories must be calculated within space and budgetary constraints. The question, then, is how does the Navy accomplish this task and thereby optimize and ensure that stocks of shipboard material will be sufficient to maintain a ship's self-sufficiency, a high state of material dependability and readiness to accomplish its assigned mission.

This paper, in effect a case study, discusses the programs and policies adopted by the United States Navy since the end of World War II to achieve the goal of optimizing shipboard supporting material. In Chapter I the parameters of the problem are discussed in terms of The Ship, The Personnel and The Organization. Chapter II traces and describes the major programs implemented prior to August, 1964. The issuance of a Navy-Wide Supply Support Policy by the Chief of Naval Operations in August, 1964 and the programs spawned by this policy are discussed in Chapter III. Chapter IV includes an overall summary of the progress attained by the Navy in achieving optimization of shipboard supporting material with additional comments by the author.

The research methodology employed is mainly the use of reference materials of a secondary nature. Previous research reports, inventory management textbooks and articles from professional periodicals constitute the bulk of the bibliography. However, the use and aid of unpublished materials and personal interviews is also included.

I would like to acknowledge the cooperation and help received from the various offices within the Navy Department and specifically from the Provisioning, Allowance and Load List Division of the Bureau of Supplies and Accounts headed by Cdr. T. J. Allshouse, SC, USN.

In addition my thanks go to Dr. J. Hart Walters, Jr. for his advice and counsel in the writing of this paper.

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CHAPTER I

THE PARAMETERS OF THE PROBLEM

The Ship

The mission of the United States Navy is to control the sea at all times in support of the national policy. The accomplishment of this mission must be effected through the use of ships. The ships cannot be expected to fulfill their assigned tasks without a well trained and proficient crew. The crew must have available the resources with which to apply their proficiency in ensuring the meeting of the ship's commitments. The resources of a material nature include fuel, food, water, physical comfort items and all classes of spare parts used by the crew in making the ship a dependable and useful element of the Navy. The basic premise of a ship's utility is its ability to be mobile. It must be able to get underway before any of its myriad tasks can be accomplished. Once it does get underway the operating dependability of its parts must be guaranteed. This can be done by placing adequate replacements for the machinery and weapons on board the ship so that properly trained and qualified personnel are able to repair these components without assistance from the shore. If there were no constraints on space or funds it would be a simple matter to carry a spare part for every requiring component and thereby guarantee that no breakdown within the physical capacity of the ship to repair it would occur for lack of a part.

The constraints of space and funds, however, are real. In particular, funding of shipboard repair parts is the more stringent. There must be a method, then, of deciding within the constraints the proper range and depth of repair parts that should be carried on a ship of the United States Navy to maximize its dependability in carrying out the mission assigned. This paper will attempt to review past, present and future techniques applied in the United States Navy to solving this complex problem.

The ship is the basic ingredient of the problem. The age of the Navy's ships is varied. In this paper ships will be classified into two broad categories, pre-Korean vintage and post-Korean vintage. This admittedly is over-simplified but will allow a more cohesive view of the two groups.

The pre-Korean vintage ships were for the most part constructed during World War II. The ships were built on an assembly-line basis and the machinery installed within them was acquired from any and all sources. Ships built in the same shipyard and from the same plans would be launched with internal machinery requiring repair parts that were not interchangeable. This did not cause any problem at that time. The ships were given an allowance list and the monetary constraint being absent they carried with them the necessary repair parts peculiar to the ship. Allowance lists for shipboard repair parts were used in the Navy prior to World War II.¹ They were maintained properly and were no doubt valuable in accomplishing

¹J. E. Hamilton, Shipboard Environment of Logistics, The George Washington University Logistics Research Project, Serial T-107/60, September 21, 1960, p. 34.

the job of optimizing the ship's dependability in terms of available repair parts. The ships constructed during World War II did indeed start with an allowance list and with repair parts peculiar and necessary to continued dependable operation. The tempo and pressure of the operations involved in the war, however, soon caused the abandonment of the allowance list. If a part was needed it was requisitioned by the ship and in turn supplied by the shore establishment. If the part had not been on the original allowance list no up-dating of the document was made. J. E. Hamilton describes the situation thus:

Allowance lists fell into disrepute. In-excess (of allowance) requisitions fell into disuse. The operating system could not justifiably enforce the rules in regard to either because it was recognized that to do so could hamper ships to a dangerous extent. The only practicable rule was tacitly to accept that the true responsibility was where it had always been -- within the ships -- and, wherever possible, if a ship asked for something to let it have it.²

As the war progressed more sophisticated weapons were added to these ships. There was no intention of adding them to the allowance list. Each new component was to be supported by a box of repair parts whose contents had been decided upon by the designers and engineers. Their decisions were based upon mathematical predictions of the probability of failure without the benefit of usage data. These boxes of repair parts were usually stored in proximity to the component or equipment. If this were not feasible the boxes were placed so that they were "not in the way." It came to pass with the change of personnel that the contents of these boxes were not known. The location of the boxes was not known. The allowance lists were out-dated or non-existent. Repair parts when required

²Ibid., p. 35.

were usually ordered directly from the shore establishment or bartered from other ships. This was the condition of shipboard Repair Part Support at the close of World War II.

The long road back from the post-World War II chaos of shipboard repair parts shall be covered in detail in Chapter II. These same pre-Korean vintage ships are still operating. They constitute a large population of the active fleet. It is true that they now have up-to-date allowance lists. It is also true that many of these 20 plus year veterans are encountering equipment failures despite frequent and thorough overhauls and interim maintenance periods. The breakdowns are occurring in equipments requiring replacement parts that were not supposed to be replaced. This supposition was predicted on the designers' and engineers' estimates during World War II. These estimates were never intended to endure for over 20 years. There is no authorized allowance for these repair parts. Since there has been no recognized demand for these parts over the years it is not carried in the Navy's Supply System. The ship in need of this part is faced with two immediate alternatives. If the part required is needed to repair an equipment essential to the ship's present mission and it is not on-board nor known to be a stocked item, then it must be acquired by salvaging or stripping a similar equipment from an inactive ship or procured locally from a known commercial source. If this cannot be done the part is ordered by the ship through the Supply System.

In many cases the original manufacturer of the equipment has long since gone out of business. If he is still in business he usually will have to tool up and make a special order. This requires contract negotiation,

high costs and worst of all, an intolerable time-span between the ship's requisition and receipt of the part on board. This same part that might have originally cost \$5 in the 1940's will cost up to \$1000 today. The ship may or may not be forced to abort its mission while awaiting the part or depend on the ingenuity of its crew to use available alternative equipments in the interim. The latter is usually more common. The natural reaction of the ship's crew is to order at least two of these parts so that this situation will not reoccur. It is true that they add these parts to their allowance list but it is also true that they may not need them for another 20 years. This practice has been justified in the past in terms of insurance. These parts are defined as insurance items. It is easy to say that occurrence of this situation on a pre-Korean vintage ship many times a year will soon increase the inventory carried by the ship in terms of both cube and investment. The constraints of space and funds preclude this practice indefinitely.

The Navy Department, including Chief of Naval Operations, Fleet Commanders, Type Commanders and the commanding officers of ships, has been involved in the solving of this problem.³ In a Staff Study conducted by a Type Commander⁴ the following information was revealed. Five ships were studied over a two year period. These ships were of the same class and type. Their operating characteristics over the period of the study were similar. They were all of the pre-Korean vintage. The study analyzed the usage

³See Appendix A for detailed explanation of Command Relationships.

⁴Unpublished study conducted by the Force Supply Officer for Commander Amphibious Forces, U. S. Pacific Fleet, November, 1964.

of repair parts on the respective allowance lists. The usage data was so similar that it was averaged with the following results:

	<u>No. of Items</u>	<u>\$ Value</u>
a. Repair Parts Allowed and On-board (Individual Allowance list items referred to as Line Items.)	15,000	\$192,000
b. Line Items indicating zero demand	13,500	\$115,000
c. Line Items indicating one demand in two years	2,500	\$ 45,000
d. Line Items indicating one demand in 90 days	750	\$ 12,000*
e. Line Items indicating more than one demand in 90 days	250	\$ 10,000

*Not including category "e."

There is strong evidence to emphasize the quantity and investment the Navy has in insurance items. This study was limited statistically in length of observation and per cent of population sampled, but it does underline and picture the slow shipboard inventory turnover rate. It substantiates the growing concern with increasing dead stock. The vital question that frames the problem of shipboard inventory management is: How much insurance can we afford?

The nature of the problem as it concerns post-Korean vintage ships is not the absolute difference in ship construction but the facts of political and economic life as they affect construction of Navy ships today and in the future.

Unlike ships built under the World War II construction techniques, today's ships are contracted for and built as single units. There may be

15 to 20 ships of one class programmed, but there are actually only two or three under construction at any one time. The Department of Defense procures many major items in quantities of hundreds or thousands, all made to the same general specifications. Ship construction and acquisition is not accomplished by mass production techniques but is characterized by unit production extending over 3 to 4 years. The basic disparities in equipments installed in post-Korean vintage ships are still occurring, but for a different reason:

Due to the Navy Department's effort to promote maximum price competition in the shipbuilding industry, all potential suppliers in most instances are separately solicited on each component as required during the construction of each ship. While the supplier's delivery time is considered in the purchase award, the shipbuilder's prime consideration in the selection of the successful bidder is the lowest acquisition purchase price. LMI could find no evidence that consideration is given to the impact the item will have upon the 'on-board' support of the ship, or on the life cost and effect on the total Navy system stock.⁵

The newest Navy ship is still afflicted by the same support problems afflicting her aging sisters. There is little or no commonality of parts among similar class new construction ships. The initial allowance of repair parts to support the ship is provided by the low-bidding supplier, who may or may not be in business when additional repair parts are required. The pre-occupation of the Department of Defense with price competition often benefits the shipbuilding contractor more than it does the Navy. A low initial cost may prove to be "penny-wise and pound-foolish" over the life of a ship. The use of performance specifications in the purchase of ship-board equipments instead of standard material specifications further compounds the on-board support problem. The performance specification allows

⁵Logistic Management Institute, Study of Ships On-Board Repair Parts Outfitting and Revision of the Present Associated Supply Aids, Task 65-13, July 6, 1965, p. 7.

manufacturers to comply by producing similar but not compatible equipments which therefore must be supported as if they were completely different systems. This not only requires different on-board repair parts but different maintenance manuals also. This in turn complicates standardization of technical maintenance training throughout the Navy.

The majority of equipments in a ship are supported by repair parts classified as Hull, Mechanical and Electrical. These IM&E repair parts are listed in one allowance list. The present policy of procurement for ship-board equipments causes each ship's IM&E supported equipments to become individual systems in terms of continued supply support. The Logistics Management Institute in its recent study of this area illustrated that:

33% of the Navy's installed IM&E equipments being supported with on-board as well as system stock inventories, are peculiar to one hull. Further, 50% of these equipments are peculiar to three or less hulls.⁶

These facts were developed for LMI by the Navy Ships Parts Control Center and confirmed by the Bureau of Ships. LMI made a detailed study to determine the degree of standardization in terms of continued supply for newly constructed ships of the same class. Four types of ships were given a detailed study to determine the similarity of installed equipments. A sample of two or three ships within each type was used with the following criteria for selection:

1. The ships were of the same class, built to a common Bureau of Ship's plan or specification.
2. Construction of the ships was started and completed on the same date.

⁶Ibid., p. 8.

3. Ships were constructed at two or more different shipyards, Navy and commercial.
4. Certain ships were selected to be representative of shipyards in the same geographic area.
5. Certain ships were selected to be representative of shipyards in different geographic areas separated by large distances.

The comparison of installed equipments within hulls of a given class of ships showed that the equipments peculiar to the two or three ships in the sample ranged from a low of 38% to a high of 58.8%. The more hulls included in the sample the less commonality of equipments for all ships compared becomes, rather rapidly compounding the parts peculiar situation.⁷

In view of this large percentage of peculiar equipments the LMI study conducted a comparison by Federal Stock Number of repair parts on the ship's Hull, Mechanical and Electrical allowance list. They found that:

. . . many items were peculiar to but one ship of its class. In fact, the peculiar parts ranged from a low of 32.7% to a high of 46.1% in the classes of ships sampled. Again, the more ships included in the samples, the smaller the complete commonality between the parts support loads.⁸

This study translates into facts and figures what has already been known intuitively by the Navy and the people who are charged with the responsibility of ensuring a ship's material reliability. Without this reliability the Navy is faced with a continuing material support problem that can only lead to present and future degradation of a combatant ship's mission readiness, both potential and actual.

The active fleet is then a combination of pre-Korean and post-Korean

⁷Ibid., p. 9

⁸Ibid.

vintage ships. The lack of equipment standardization is common to both. The constraints on space and funds available to store and procure on-board repair parts are also common. The allowance lists on all Navy ships today are up-to-date and under continuous scrutiny.⁹ The one other major segment of this ship-oriented supply support problem is the demand by the ship for repair parts not designated in the allowance list as allowed nor carried on-board in excess of allowance. These items of repair parts are classified as Not Carried (NC). The NC items are identified by a Federal Stock Number (FSN) or by the manufacturer's part number. They may be listed on an allowance list for information purposes or they may be listed in the manufacturer's maintenance manual for the equipment involved. The NC items are not on-board due to lack of previous need or because they may be too expensive to justify shipboard stocking.

In order to understand more clearly the demand characteristics of NC repair parts the Commander, Cruisers Destroyers, U. S. Atlantic Fleet conducted a 15 month study of this problem as it affected 198 destroyer type ships. In coordination with the Bureau of Supplies and Accounts and the Navy Supply Depot, Newport, R. I., this study commenced on January 1, 1964 and concluded on March 31, 1965. Commander Cruisers Destroyers, U. S. Atlantic Fleet (COMCRUDESANT) was chosen to conduct this study due to their system of attacking the NC repair part problem in an aggressive manner. Aboard COMCRUDESANT destroyers there is a system that operates to react to Not Carried repair part demands. As soon as a ship leaves

⁹ See Chapter II for discussion of the procedures involved in allowance list construction and implementation.

overhaul, a file is started for demanded items which are not in the ship's allowance list. If any item in this file receives a second demand, the item is added to the allowance list; its descriptive card is then removed from the file. When the ship returns for overhaul, this file is destroyed and a new one started. The Bureau of Supplies and Accounts requested that COMCRUDESANT compile the NC demand data in such a manner so as to build a demand frequency distribution. There were a total of 44,000 cards analyzed. These cards were divided in two sets: Manufacturer Part Numbered Items and Federal Stock Number Items. They were fed into a computer with the following results:

TABLE 1

NOT CARRIED (NC) REPAIR PART
DEMAND FREQUENCY DISTRIBUTIONS*

Frequency	Part Numbered Observations	FSN Observations
1	4,241	13,393
2	391	3,414
3	104	1,362
4	35	686
5	14	441
6	3	264
7	1	171
8	2	112
9		98
10		63
11 - 15		170
16 - 20		50
21 - 30		40
31 - 50		14
Over 50		0

*Source: ALBAND unpublished Working Memorandum 66 of July 26, 1965.
Subject: Use of Destroyer Demand for "Not Carried" Items to Improve COSAL Range.

This study shows that over 50 per cent of parts demanded only had a frequency of one. The problem is one of vast range to support peculiar demands. The question then arises, how can the Navy maintain its material readiness in light of the enormity of the repair part support problem? The answer lies in the other half of the overall problem of Inventory Management of Shipboard Repair Parts, the people factor. The essential element, the unpredictable element, and the saving element of any ship is its crew. The American sailor's initiative is another constraint on material readiness afloat.

The Personnel

The ship is an inanimate machine until it is given a crew. The crew consists of officers and men of varying technical skills and depth of experience. The crew comes aboard a new ship in increments dependent on the time involved in various phases of construction. Only on a new ship is the crew in its entirety a novice in terms of knowing the ship.

After completion of construction and the official commissioning of the ship, the personnel, the individuals embarked and assigned to the ship, will begin the sociological experience that in the end shall make them a crew in fact.

The ship then commences a series of post-construction shake-down cruises. These cruises enable the personnel, from the captain to the seaman, to learn the idiosyncrasies of their ship. They steam her at full speed, they steam her in reverse, they run her machinery, they note the design features that must be corrected and they begin to think of the ship as "she" and each other as "shipmates." The construction phase ends when the captain

of the ship certifies that it is ready for sea. The ship is then assigned to an underway training group. Weeks of operational drills are conducted with the personnel acting as a team. There are drills in seamanship, drills conducted to simulate battle damage and hundreds of drills to test and train the men and machinery in order to achieve a cohesive well coordinated fighting unit. Upon completion of this underway training the ship reports to its Type Commander for duty and is assigned to a squadron as part of the active fleet. The personnel, the individuals assigned, are now a crew. They know each other as to needs and goals and what is even more important they are beginning to know their ship. They are learning what she can do and what it takes to ensure that she will continue to function. The sailor in the Engineering Department knows that a certain pump requires more lubricant than the manufacturer has specified. He knows that without it the pump will burn out its bearings. The manufacturer has made hundreds of these pumps and this one is an exception in its lubricating requirements. Why? There is no absolute answer but it is vital that the sailor who maintains it be knowledgeable of its thirst. The radarman has come to know that his radar burns up a certain power tube at double the manufacturer's predicted rate. The radioman, likewise, is aware of the extraordinary consumption of coils required by his radio. These men and all the members of the crew begin to know what it takes in the way of material to keep their machinery operating. A sailor knows the ship's store only sells cigarettes on certain days at pre-set hours and knowing this purchases enough cigarettes when it is open to last

him until he can get to the store again. He keeps the extra cigarettes in his locker with soap and razor blades. In the same way the sailor knows that the parts required by his machinery are not always available and he must hoard them against this eventuality.

In a ship, as in any unit of endeavor, there is the formal organization and the informal organization. The formal shipboard supply organization is the Supply Department. The head of this department, the Supply Officer, is a member of the Navy Supply Corps.¹⁰ The Supply Department is charged with responsibilities of logistical support of the ship from shipboard sources. The Supply Officer is the man who must produce the needed material no matter where the ship may be and whenever the material is needed. This material is divided into three major categories: Repair Parts, Consumables and Equipage. These categories are not always clear cut and there is often misunderstanding in which category certain material belongs. In this paper Repair Parts is defined as that material which is required in maintaining or repairing machinery, installed or portable, and whose physical characteristics would not be considered Consumable. Consumables are defined as materials that are not directly related to machinery support and which typically are physically consumed by the user. The exception to this would be an equipment related consumable such as a prefabricated gasket or special paint for a specific equipment. Equipage encompasses all material not covered in the previous categories and ranges from electronic test equipment, typewriters, lifejackets, and binoculars down to the ship's official seal.

¹⁰The Supply Officer in most submarines, minesweepers, landing ships and other small ships, is a line officer with a collateral or primary duty as Supply Officer.

The formal shipboard supply system ensures that the proper quantities of Repair Parts, Consumables and Equipage are on board at all times and available for issue whenever they are needed. The material is stocked in bins and drawers within storerooms under the custody of the Supply Officer. If a sailor requires material from one of these storerooms he must go through one of the following procedures. In this example a sailor requires some rags. He requests them from his immediate supervisor, a first class petty officer, in the form of a storeroom request. The first class petty officer approves the request by initialing it and the sailor takes it to the division chief who approves it similarly. Then he goes to the department officer for final approval and budget entry. The desired item is chargeable to the department's quarterly budget and therefore must receive approval from the department head or his designated representative. The sailor then can present the approved requisition to the storeroom storekeeper and receive his rags. This is the way the formal supply system works. A variation of this system is use of department credit cards to draw material from the storeroom. These cards are held by the department head and a few designated persons within the department. The sailor must go to one of these people to get the card and thence his rags. One can understand why a sailor that used rags daily would not want to go through this hierarchy very often.

The sailor requisitions a sufficient quantity of rags on one trip to the storeroom to preclude frequent trips. He then finds a locker that he alone has access to and keeps his supply of rags in it. He now has what

J. E. Hamilton¹¹ refers to as the first echelon of supply in the informal shipboard supply system. There are other similar items in the locker such as brightwork polish, line, handtools and hundreds more. Similarly the division has a locker that is the domain of the chief petty officer. In this locker will be found larger quantities of rags, brightwork polish and line. Additionally there is a wider range of articles and material reflecting the prior and future needs of the division in accomplishing its jobs. If a sailor can't find what he needs in his own locker he has ready access to the division locker. The department head does not like to be dependent upon the Supply Officer for his needs and feels he can more readily control his resources by stocking the most demanded items in the department's own storeroom. In this storeroom will be large quantities of paint, automatic and hand tools and literally tons of line, rope cable and foul weather clothing.

The informal supply system is fixed within each department. The difference is only in the location of "ready access storerooms" and in their respective contents. The sailor in the Engineering Department stores quantities of lubricant close to his pump, along with spare parts, tools and any needed supporting materials. The radarman has at least six power tubes in a cabinet close to his radar. The radioman also has his coils close to his equipment. These stores are pyramided through each department and constitute an imposing source of supply.

Directives are received from all levels decrying this practice and pointing to the damage incurred to the formal supply system in terms of

¹¹J. E. Hamilton, op. cit., p. 7.

inaccurate usage data generated by this procedure. The importance of central inventory control and issue is stressed over and over. The crew understands, but the informal system persists. When asked why he must keep his power tubes close to his radar, the radarman answers that the time involved in drawing one tube from supply is too long, considering the importance of the radar to the ship's safety. In the same vein comes the response from the radioman. The sailor with his rags cannot abide expending half of every day to draw a handful of rags. The intent of all these men is one that should not be changed. They are trying to get their jobs done and done well so that the ship can perform the way she was built to perform.

The idea that the informal supply system is not detrimental to overall ship readiness has many supporters. They ask, what is the harm of a pyramid of supply throughout the ship if it was originally requisitioned through the formal supply system? There is logic to this point of view and there would be no harm if what is purported were an actuality. If all material (Repair Parts, Consumables and Equipage) were in fact requisitioned from the Supply Department storerooms or were recorded as material bought by the Supply Department for use by another department on a direct-turnover (DTO) basis there would be no harm. There would be usage data generated with which the Supply Officer could project future requirements. Since Consumables are not stocked in accordance with an allowance list but on a usage and frequency of demand basis, there would be fewer stockouts and less overstocking of Consumables. The allowance list restraints pertaining to Repair Parts and Equipage could be adjusted as required to meet the realities of the ship's needs. The informal supply system would facilitate

distribution within the ship and reduce the day-to-day load on the Supply Department. This would all come about and be an accepted way of life if it were not for the one fly in the ointment -- money. Money makes the informal supply system a diluter of the formal supply machinery and erodes the concept of central shipboard inventory control and supply distribution.

The erosion takes place over long periods of time in the manner of a barter system. The ship receives money on a quarterly basis from the Type Commander. This money is then allocated to the departments. The departments never have enough money to satisfy the depth of demand required by the informal supply system. As a result, a sailor will enter the grey market of Navy supply. The symbol of this bartering arena is the can of coffee. The radarman cannot get the power tubes in the quantities he requires or thinks he requires with the funds available to him through his department. He is aware that he can get these tubes by trading five pounds of coffee to a shipyard electronic repairman. The radarman is a close friend of the ship's cook and soon the transaction is made. If coffee is not available other commodities are substituted. This type of transaction occurs throughout all levels and in all departments of the informal supply system. No record appears of these transactions in the formal shipboard supply system. The result is that, in the case of the power tubes, the Supply Department records no demand on these power tubes over many months. Since there is no demand they may be transferred to another ship or turned in ashore for monetary credit. The first time the formal supply system receives a request for these power tubes is in the middle of the ocean, during a typhoon, when the radar is the most vital equipment aboard. The

radarman has exhausted his informal storeroom, and being separated from the grey market must turn to the formal system for support. The support is not there and then the excitement commences. Radio messages fly in all directions with emergency requisitions for the power tubes and the supply department is blamed for failing in its mission. It has failed, due to the ingenuity and aggressiveness of the American sailor.

This situation is an exaggeration, but when the compound results of the informal supply system are inflicted on the formal system, material support over extended periods of time is impaired if not actually degraded to a dangerous level. The personnel make the ship go and in their enthusiasm may be the cause of its not being able to do the job it was built to do.

The Organization

The third and final segment of the problem of proper inventory management is the organization of the Navy in regard to inventory management of shipboard material. Shipboard support is the most regulated, documentized and scrutinized area in the ship. The ship is inundated with directives from the Secretary of Defense,¹² The Secretary of the Navy, The Chief of Naval Operations, The Fleet Commander, The Type Commander, The Squadron Commander and The Division Commander. In addition manuals, directives and letters of instruction flow from the Bureau of Ships, the Bureau of Supplies and Accounts, the Bureau of Weapons, the Bureau of Yards and Docks, the Defense Supply Agency and their inventory control points. The Navy Supply System issues procedural directives from the Navy Supply Centers,

¹²See Appendix A, Exhibit 1 for Organization Chart.

the Ships Parts Control Center, the Electronic Supply Office and the Mobile Logistic Support Units. Many of these directives are uncoordinated, and even more are contradictory.

The organization of the Navy affects not only the Supply Department of a ship. It is omnipresent in all functions. It involves the Supply Department in a voluminous paper barrage. The flow of information and policy pertaining to shipboard inventory management is not merely redundant and confusing, but is also self-eliminating. A point of diminishing returns is reached when the recipients of these directives have achieved their saturation point. It is difficult enough to manage a shipboard inventory on a day-to-day basis without having to consider the consequences of a management decision in light of many contradictory directives. The simple act of requisitioning material can be a frightening exercise. The material has a Federal Stock Number and a code describing what segment of the overall Federal Supply System has cognizance of the material. The Supply Department receives reams of Federal Stock Number changes monthly. These tell the ship Supply Officer that an item that was under the Navy's Electronic Supply Office is now under the Defense Electronic Supply Center. If the Supply Officer does not inscribe his requisition with the current code and Federal Stock Number he may slow the eventual receipt of the needed material by months, or in extreme cases, the requisition will be lost in a computer. If the Supply Department in a ship kept all the changes in this one area current, that is kept strict account of the stock number migrations, it would have time for little else.

The Fleet and Type Commanders are responsible for ensuring that

a ship will have the material endurance in terms of days to be self-sustaining under combat conditions. The Fleet prescribes these endurance levels in an operational directive and the various Type Commanders have the prerogative of increasing these levels in their own directives. In many instances, converting a quantity of repair parts required by an allowance list prepared by the Bureau of Ships into days of endurance has been and is still an impossibility. Endurance levels have been standardized by the Chief of Naval Operations and the impact of this will be discussed in Chapter III.

The effect of conflicting directives and policies on the operation of the Supply Department of a ship could well be a paper in itself. This has been and shall be an important segment contributing to the problem of optimizing inventory management of shipboard material.

Summary

The parameters of the problem of optimizing inventory management of shipboard material have been discussed as a three-segment problem.

The Ship. The construction of both pre-Korean vintage ships and post-Korean vintage ships, although for different reasons, resulted in Navy ships with installed machinery and equipment that were peculiar. This individuality in pre-Korean ships was due to the need for machinery at the moment, without regard to the source. Mass production methods employed in construction of these ships did not take into account the problems of future material support for these varied installed equipments. Allowance lists were ignored or abused so that by the end of World War II the state

of material support based on shipboard allowances was in chaos. The post-Korean vintage ships are constructed on a unit method in different shipyards throughout the country. Competitive pricing is the policy used to procure bids for installed equipments and machinery. The low bidder receives the contract and since the equipments are built to performance standards there is peculiarity in-built by variances in construction as well as manufacture. This poses a difficult support problem in terms of standardization and technical training for members of a ship's crew.

The Personnel. The individuals that comprise a ship's crew soon become a working team. In their individual enthusiasm and ingenuity they build within a ship an informal supply system that is pyramided at every level and in every department. This informal supply system stockpiles material but does not necessarily requisition the material from the formal supply system. The use of the barter system to support the informal supply system causes a breakdown when the source of supply in the informal system is not available. Requirements have not been recorded in the formal system and support is not available when the user finally goes to the formal system for material.

The Organization. The complex organization of the Department of Defense and in turn the Navy increases the task of the shipboard Supply Department in performing its duty. The volume of conflicting and uncoordinated directives do nothing to aid the Supply Officer solve his problems. This segment is probably the most serious and complex.

CHAPTER II

MAJOR PROGRAMS PRIOR TO AUGUST, 1964

Coordinated Shipboard Allowance List (COSAL)

The conclusion of World War II found Navy ships in a disorganized state insofar as inventory management of shipboard material was concerned. The allowance lists had not been maintained and updated, and additional equipments had been added without the benefit of any acknowledgement by the ship. This in turn was not reported to the Bureau of Ships, and therefore there was no system wide support for these equipments. The allowance lists found in our ships at this period in time were of three basic types. The first was a Revised Master Allowance List, including all types of material under the cognizance of the Bureau of Ships, that was approved for installation on all the ships in the fleet. The second type was the Type Allowance List. This included the material installed on certain ships of a type, i.e., destroyer, cruiser, battleship, or a class within a type, i.e., destroyers built to one set of specifications and plans. The Type Allowance List was the basis for the preparation of the Individual Allowance List, the third type. This third type was the allowance list prepared for an individual ship. These three types applied only to Bureau of Ships items. There were actually four different allowance lists of which the three types were only two. The Bureau of Ships, The Bureau of Ordnance, The Bureau of Aeronautics were thus the technical bureaus in

control of shipboard allowances for items under their jurisdiction. Each category of material under a technical bureau was under the management control of an inventory manager. The inventory manager was under the technical control of a technical bureau, but in reality, under the management control of the Bureau of Supplies and Accounts. The following breakdown might aid in clarifying the relationships to the four different allowance lists:

<u>Scope</u>	<u>Technical Bureau</u>	<u>Inventory Manager</u>
Machinery & Electrical	Bureau of Ships	Ships Parts Control Center
Electronics	Bureau of Ships	Electronic Supply Office
Ordnance	Bureau of Ordnance	Ordnance Supply Office
Aviation	Bureau of Aeronautics	Aviation Supply Office

The allowance lists were prepared in different formats based on the differing philosophies of the technical bureaus. The technical bureau would design, procure, install and provide for initial equipment support of an item and prepare a recommended allowance list for the equipment. This list was then forwarded to a naval shipyard which was assigned the responsibility of preparing an individual allowance list for equipments designated as its responsibility. These shipyards were known as allowance list preparing activities. The formats used by individual preparing activities were not standardized. The inventory manager was responsible for planning, stocking and distributing material required to support equipments in the shipboard allowance lists. Identification of what

departments managed what material was made by an alphabetical cognizance symbol. The following are examples:

Components (Complete Equipments)

Cognizance Symbol

Responsible Activity

S Cog

BUSHIPS, Hull, Machinery & Electrical

F Cog

BUSHIPS, Electronics

Parts for Components

H Cog

Ships Parts Control Center

N Cog

Electronic Supply Office

These cog symbols prefixed the stock number of the equipment or the repair part in the allowance list. James V. O'Conner¹ and J. E. Hamilton² go into great detail on this particular subject. The array of allowance lists alone were a challenge to the stamina and ingenuity of the ship's crew in identifying a needed repair part so that it could be ordered. The individual allowance lists required the user to possess a depth of knowledge of the ship in regard to its equipments that many could not possibly attain. Therefore if a required part could not be properly identified the ship would inscribe complete component identification on the requisition. This included the group, page and line number from the allowance list, the name plate data from the disabled equipment and all other identifying information. The

¹LCdr. J. V. O'Conner, SC, USN, The Effect of the Coordinated Ship-board Allowance List Over the Revised Individual Allowance List, Professional Paper on Supply Management, September 29, 1958. (Unpublished)

²Hamilton, op. cit., p. 6.

shore supply activity would then have to research the requisition to produce the complete Standard Navy Stock Number and cognizance symbol before supplying action could be taken.

The shipboard allowance lists of this era were prepared and maintained manually. The upkeep, when data was properly supplied by the ships, was an enormous operation requiring hundreds of clerks. This system might still be in use today if it were not for the fact that the rapid growth of the Federal Agencies during World War II spurred a move to centralize procurement for all of the Federal Government. The first step in this centralization was to assign a Federal Stock Number (FSN) to all materials and equipments used within the Federal Government. The effect of this move on the allowance list system used aboard Navy ships was significant. It was estimated that a one time conversion of Standard Navy Stock Numbers to Federal Stock Numbers in shipboard allowance lists would require a minimum of 20,000 man years.³ This estimate was based on a manual conversion and did not include the changes that would be accumulating while the initial conversion was in process. It was obvious that the conversion would have to be made with the aid of automatic data processing equipment.

Concurrently with the advent of the FSN conversion the Bureau of Ships was developing a new type of shipboard allowance list. This new allowance list was to be a comprehensive listing of all equipments installed in a ship regardless of which bureau or inventory manager had cognizance. The new allowance list, which would be coordinated among the bureaus so

³Brought out in an interview with Mr. J. Gumenick, Head of the Allowance and Load List Branch in the Bureau of Supplies and Accounts.

that the format would be uniform and included in one list under one index, was named Coordinated Shipboard Allowance List (COSAL).

The requirement to convert all Navy stock numbers to FSN and the knowledge that machine processing was required gave impetus to the proposition of redesigning the allowance lists at the same time the stock number conversion was being processed. The ADP machinery could do both jobs at the same time, and one giant step forward in shipboard management of material could be attained. The COSAL concept was accepted by all echelons involved and implementation commenced.

The vital step in preparing the new COSAL's was delegated to the crew of a ship. They were instructed to review their individual allowance lists and validate that an item listed as an installed equipment on the allowance list was in fact the same equipment installed in the ship. The validation of an allowance list on the ship requires a wall to wall inventory of the installed equipment. Each and every piece of equipment must be physically inventoried and checked as to manufacturer, model and type to insure that the allowance list accurately describes it and its repair support. If this is not done conscientiously, the repair support for equipment no longer installed will remain aboard a ship and serve only as ballast. Many ships conducted the validation fully realizing its importance and many did not. The validated allowance lists were then sent to the technical bureau having cognizance and thence were forwarded to the Bureau of Ships and converted into COSAL's.

The COSAL format is designed for the shipboard user so that needed material can be quickly identified in more than one way. It is a simple

document broken down into three basic parts. Part I is the index, a series of cross reference listings. To describe the listings it is necessary to understand some of the terminology used. A component as used in COSAL language is an entire equipment such as a radar or a part of an entire equipment that in itself is supported by one or more Allowance Part Lists. An Allowance Part List is a listing of repair parts allowed and the quantities of each required to support a component. A Component Identification Number is the number used to tie the Allowance Part List to the component. A Service Application Number ties a component to a larger equipment. The COSAL index, then, is constructed of three separate listings. The first is a summary listing of Allowance Part Lists (APL's) included in the COSAL in numerical sequence of Component Identification Numbers (CID's). The second is a listing of components supported by the COSAL in nomenclature alphabetical sequence referencing applicable CID numbers which identify the supporting APL's. The third part is a listing of components supported by the COSAL in Service Application Number sequence referencing applicable CID numbers.

Part II of the COSAL is a numerical order assemblage by CID number of all the APL's providing support in the particular ship. Each APL consists of a written description of the applicable component characteristics and identifying data. There is also a repair parts listing with the following data included: FSN or Manufacturer's Part Number, population of the installed component being supported by this APL, unit of issue, quantity allowed based on allowance selection tables.

Part III is a Stock Number Sequence Listing of all material in the

COSAL. This list is in sequence and also provides the item name, the applicable CED's, notes, unit of issue and the allowed quantity.

This COSAL is an improvement over the old allowance list because it facilitates the identification of required material. The user does not need a stock number to identify a needed part and can quickly ascertain if a required item is allowed. The fact that the COSAL is convenient, inclusive and up-to-date does not guarantee that the allowed material is in fact on board ship. The COSAL was the first major program in the overall galaxy of programs that were instituted by the Navy in order to improve the inventory management of shipboard material and thus optimize the ship's capability to be self-sufficient over long periods of time away from sources of supply. In itself the COSAL could not accomplish the goal and it was not intended to do so. The continuing migration and change of FSN's and the continuous change and addition of installed equipment in a ship soon made the COSAL obsolete before the latest editions were off the press. It was generally agreed that a ship could not keep up with rapid and multitudinous changes that would affect its COSAL. It was further agreed that a continuing program was needed to accomplish this adjustment, which was the next major program invoked by the Navy.

The Supply Operations Assistance Program (SOAP)

The accuracy of the first COSAL was predicated on the validity of the ship's individual allowance list. Similarly, the validity of a ship's second COSAL was based on the validity of the first. The arrival of the COSAL did not eliminate the problems associated with continuous updating of

this document. There were many instances when ships could not apply the current FSN's to their requisitions for material. This caused the requisitions to be rejected by the supply system, and if not rejected they were slowed or lost. There had to be a method applied to this continuing problem to arrive at a satisfactory solution.

In the past, the operational commitments of Navy ships did not allow a period of time long enough to accomplish an allowance validation during normal deployments and training evolutions. The one period of time that a ship was not committed to fleet oriented missions was when it entered a shipyard for its regular overhaul. The regular overhaul occurred every 24-30 months depending on schedules, available funds, and shipyard workload. It was believed that since the regular overhaul was conducted for at least two months that this would be the only time available in the shipboard operating cycle to properly accomplish an up-date and purification of shipboard support material. In 1959 the Supply Operations Assistance Program (SOAP) was implemented to do this.⁴

The SOAP was originated and managed by the Bureau of Supplies and Accounts. The scheduling and overall supervision was the responsibility of the Commanders of the Atlantic and Pacific Fleets. The Type Commanders were the actual supervisors, since they held the funds for their respective ships for the purchase of deficiencies uncovered. SOAP was soon described as a supply availability or supply overhaul since it was conducted during

⁴U. S. Navy, Bureau of Supplies and Accounts, Instruction 4441.12 (BUSANDA Instruction 4441.12), SOAP Manual; Promulgation of, May 20, 1964. (Revised).

a ship's regular maintenance overhaul in a shipyard.

Under the organization of this new system, a SOAP team was assigned to naval shipyards. The SOAP team consisted of an officer of the Supply Corps and a number of experienced senior chief storekeepers, as well as senior storekeepers who were assigned as representatives of each Type Commander. The Type Commander representatives insured that ships of their type complied with specific SOAP policies as promulgated by respective Type Commanders. Specialists from the shipyard were assigned or available to the SOAP team to aid in aspects of technical supply requiring material identification. There are many parts in a ship that are improperly numbered or have no identification. The expertise essential in identification of parts is a vital element in the supply overhaul. The SOAP team had assigned to them large areas of warehouse for material stowage and processing. They also had computer time available to run listings picturing the finished product. The listings will be investigated in detail as the SOAP process is explored.

The SOAP program was designed so that when a ship entered the shipyard for its regular maintenance overhaul, all repair parts in storerooms of the ship's formal supply system would physically be offloaded and placed in the SOAP team warehouse. With the aid of assigned members of the ship's crew the entire load would be counted, identified and preserved as needed by the SOAP team personnel. Upon completion of the inventory the material would be checked against the COSAL to determine the excesses and deficiencies. The criteria imposed on this determination was usage and the quantity allowed in the COSAL. The first ships to complete the SOAP

often found themselves in embarrassing straits when within days after completing their overhaul they would be in dire need of a part that had been off-loaded as an excess. There was a hue and cry from many quarters that this SOAP program would be the end of shipboard material readiness. The program was in jeopardy of termination after only a six months' operating history.

To comprehend fully the reason for this unfavorable reaction, it is necessary to try to understand the events prior to a ship's overhaul. The ship has just received the letter of instruction from the Type Commander explaining the SOAP program and the ship's part in it. The Commanding Officer reads the letter and immediately calls for the Supply Officer. He shows the letter to the Supply Officer and tells him that this will be his project. He informs the Supply Officer that the ship can only spare Supply Department personnel to go ashore and inspect these repair parts. The other departments need all their people for the maintenance overhaul. The repair parts are Supply's responsibility and the program itself is disruptive to the normal overhaul routine. The Supply Officer therefore shall take complete charge and not involve anyone else in this "Supply Evolution."

The letter of instruction also requires that the ship conduct an equipment validation of the COSAL. This must be completed 60 days prior to entering the overhaul yard to ensure completion of the revised COSAL upon completion of the overhaul. The Supply Officer knows that his people, the storekeepers, commissarymen, ship's servicemen, cannot validate the equipments installed since they could not identify them if they did locate them.

A Navy ship is a maze of primary and auxiliary systems with equipments and components buried in every nook and cranny of the hull. The physical inventory and validation can only be done properly as a shipboard effort comprising all the expertise of individual and group specialties. The captain insists that this is Supply's bailiwick and he can ask the other department heads for assistance on the validation on a non-interference basis.

The validation is conducted by each department on a non-interference basis which actually results in a spot check of respective department equipment against the COSAL and acknowledgement by the department head concerned.

When the ship arrives in the shipyard, the repair parts are off-loaded as rapidly and haphazardly as possible on a non-interference basis. The Supply Department personnel are the only members of the shipboard team that process the material under the guidance of the SOAP team. Often a part being processed is found to be a not-allowed item. The SOAP team personnel inquire of the ship's personnel as to its importance in the ship. The part may have been omitted from the allowance list in error and actually is a critical repair part in support of an essential component or equipment. It had no usage but is aboard as an insurance item. The storekeeper on the ship's team has no idea what its function is and since it is not-allowed and indicates no demand he decides that it should be off-loaded as an excess repair part. If this decision making process is repeated a hundred-fold, it is clear that the results will cause a hue and cry against the SOAP program. The ship now has a COSAL that does not reflect installed equipment

and does not provide for proper support of the equipment actually installed.

Situations like the above were often the results of shipboard attitudes, and the Type Commanders were aware of this. They knew that SOAP would be the answer to many of the problems faced by their ships in maintaining an optimal shipboard load of support material to make them self-sufficient over extended deployments. As a result, they instituted an educational program to teach the officers and men in their ships that the benefits of a proper supply overhaul were shipwide and not just for the improvement of the Supply Department. They directed that a Commanding Officer make every effort to ensure that his ship was combat ready in all respects including material readiness. The SOAP program would benefit and improve shipboard material readiness and therefore must receive the Commanding Officer's personal attention. The SOAP program became an all hands evolution as a result of this educational program and has grown to be an important phase in improving inventory management of shipboard material.

The awareness by Command of the importance of reliable shipboard material support has led to the environment that surrounds the SOAP program today. The Captain now calls a meeting of all department heads and explains to them the importance of an accurate, thorough, hull-to-hull inventory of installed equipments. He directs that validation teams be organized consisting of members of all departments. A compartment-by-compartment validation schedule is instituted and complied with. Equipments and components are visually sighted and tagged to acknowledge inspection. If there are any variances between nameplate data and those described

in the COSAL the changes are noted in the validation team's working copy of the COSAL. The validation is now complete and accurate and the revised COSAL will reflect the material needs of the ship.

The Supply Officer is nominally in charge of the program but he receives full support from the Commanding Officer. The haphazard off-load of material no longer occurs. One month prior to the overhaul the Officer-in-Charge of the cognizant SOAP team boards the ship and in company with the Supply Officer inspects the storerooms. He takes an estimate of the amount and physical deterioration of the storeroom stock. The results of this inspection are used as a basis for his personnel requirements that the ship must fill as part of the supply overhaul. The Officer-in-Charge of the SOAP team then holds a meeting with the ship's Commanding Officer and explains the details of the personnel requirements and the off-load plans. In addition, the ship's Supply Officer is requested to make schematic drawings of all his storerooms so that the SOAP team can recreate them as a mock-up in their warehouse space. The bins and drawers containing the support material are numbered and identified so that the entire bin or drawer's contents is off-loaded as a unit and placed in the SOAP mock-up. There is no more time lost in sifting through piles of parts. This procedure is an efficient and improved method of physical inventory.

The ship's team is constituted of members of every department that are qualified in their specialty and also have acquired knowledge of the ship's needs. If the part referred to earlier is not on the allowance list and has no usage history the decision to keep or off-load is now made by an expert. There are far less embarrassments to the ship due to an off-load

made in ignorance. The hue and cry against SOAP has changed to a demand for extensions of the program.

In addition to the benefit to the ship in the form of accurate inventories and allowance lists, the benefits of the data accumulated as the result of the SOAP are passed along to Type Commanders and the higher echelons. The most important is a comprehensive listing of allowance list deficiencies. This listing includes the stock number, the nomenclature, the allowed quantity, the quantity inventoried, the quantity deficient, the unit cost and the total cost for funding the item. Costs are subtotaled by application, i.e., Hull, Machinery and Electrical, or in any manner the Type Commander might desire. Total cost is also indicated. The Type Commanders differ as to their policy in funding SOAP deficiencies prior to the ship's overhaul completion and the ship is forced to go to sea with a list and no material. Others have seen fit to fund all deficiencies. Many have typically funded deficiencies in range only. Range in this sense is buying one repair part when three are allowed and three are deficient. The by products of the use of SOAP also include a frequency of demand listing which reconstructs the number of issues for each item over the period between SOAP's. This was not available in the first generation SOAP due to the sparsity and accuracy of usage data but it is now used in establishing inventory management policy at a shipboard and system level.

The SOAP program is often viewed as a crutch that tends to reduce awareness of day-to-day shipboard material management by responsible personnel. The argument continues that one or two SOAP's should be

sufficient and then the ship's Supply Department should be required to maintain the high support level acquired. The majority opinion in the Navy is that SOAP may be a crutch, but it is a necessary and beneficial program. The majority has ensured the continuation and extension of this worthwhile program. The extension will be discussed in Chapter IV. The improvement in ship reliability in terms of increased dependability of shipboard material support can be attributed, in part, to the continued and increased Command interest in this area brought about by the SOAP program.

Military Essentiality Coding (MEC)

The techniques developed during World War II in applying statistically developed quantitative values to strategy and tactics in what is known as Game Theory stimulated similar techniques in all areas of problem solving. The overall field involving these techniques is known as Operations Research. Operations Research attempts to solve a problem by assigning quantitative weight to the various factors that must be taken into account in solving the problem and the relationships of these factors to one another. Once these factors are quantified they are then expressed in mathematical terms in equation form. The series of interrelated equations is called a model. The model can be constructed to maximize gain (profit) or minimize loss when applied to the solution of the problem. Newman and Sumner list three characteristics of problem situations in which Operations Research is valuable:

1. A problem is so complicated or involves such a sheer mass of data that it cannot be fully grasped by one single person's

mind, and yet its parts are so interrelated that dividing it into comprehensible units would not necessarily yield the best answer.

2. The relationships are known, clear-cut, and of a type that can be expressed by available mathematical formulae.

3. Statistical data are available for all important variables.⁵

The characteristics inherent in business problems lend themselves to solution through the techniques of Operations Research. The one business problem that is ideally suited to solution using this technique is inventory management.

The basic problem of inventory management is having the right amount of stock on hand -- neither too much nor too little. Fundamentally, inventory control is deciding how much to buy and when. The basic problem in shipboard inventory management is to construct an allowance list that will provide support for installed equipments over an extended period of time within space and budgetary constraints. The simplest model used in solving inventory management problems is the Economic Order Quantity (EOQ). It is expressed algebraically as:

$Q \text{ equals } C \text{ times the square root of } Y$

Where C is the cost factor and Y is the yearly demand in dollars

This basic formula does not take into consideration such factors as warehouse space, quantity discounts and transportation costs. Variations of this basic formula are used to include these variables. The basic premise of EOQ is that demand is predictable if it is based on usage data. Where

⁵William H. Newman and Charles E. Summer, Jr., The Process of Management (Englewood Cliffs, N.J.: Prentice-Hall, Inc.), March, 1965, p. 319.

demand criteria are not available the problem is normally solved by the application of judgement based on past experience. This is the basis for the majority of items on the shipboard COSAL. What if the judgement applied is in error? The price of bad judgement in allowance list construction could mean the total degradation of a ship in accomplishing its assigned mission. The EOQ model is not capable of solving this problem by itself so other means must be considered.

The fact of the matter is that we cannot predict the demand with certainty. We must, therefore, decide upon an objective which we will attempt to achieve. For items of a critical nature the objective might well be never to run out of these items.⁶

A ship must run out of the critical items. What are the critical items? Who must decide on what is critical or non-critical? Should it be a technical bureau or the ship? The answer is intuitively obvious. The critical nature of an equipment and its support can only be decided by the shipboard personnel who live with and are surrounded by the equipments 24 hours every day. The COSAL and all its format refinements did not reflect the critical value of allowance items. There was no weight assigned to a repair part that would establish its military worth or essentiality in relation to all other items in the allowance list. If a weight could be assigned to each equipment, component and supporting repair parts it would undoubtedly abet the optimizing of shipboard inventories to sustain material readiness. The assigned worth or essentiality could serve the dual purpose of stocking and expediting when the part was

⁶Mina Haskind Gouray, A Non-Mathematical Discussion of the Allowance List Problem, The George Washington University Logistics Research Project, Research Summary Report No. I, December 10, 1956, p. 2.

requisitioned.

One of the first formal studies in the area of military worth was begun by the Navy in 1958 with the following objective:

The approach (of this study) is based upon a consideration of two interdependent factors as influencing the seriousness of part shortages. One of these is MISSION EFFECT which measures the effect of component failures on the ship's ability to execute its assigned mission. The other, MAINTENANCE POTENTIAL, has to do with the effect of end item or part failures on the operability of the parent component. Where such failures would render the parent component inoperable, MAINTENANCE POTENTIAL considers the capability of the ship's force, in the event of a part shortage, to maintain the component in a satisfactory operable condition through on-board manufacture of the required part, and/or cannibalization, and/or the employment of jury-rigging procedures. Part shortages are relatively more serious when, in the event of such a shortage, on-board manufacture, cannibalization, and jury-rigging are not feasible.⁷

Mission Effect and Maintenance Potential were the two elements used in this initial study to determine the military worth of repair parts. The methodology used was as follows:

Military worth questionnaires for each of these elements were developed by the Project team. Since the immediate concern was the use of worth evaluations in the allowance list area, a decision was made to obtain worth estimates for the total component and installed part range of a single combatant ship. The fleet submarine, USS TIRU (SS416), was chosen for this purpose. Approximately 1,300 components were evaluated. These include the four standard component classifications: Mechanical and Electrical; Electronics; Ordnance; Equipage and Portable. Evaluations were also obtained for approximately 31,600 spare part applications of various cognizances for these same components. Components were evaluated by qualified submarine officers. Parts were evaluated by enlisted submarine personnel, and by civilian technicians of participating Supply Demand Control Points. Three independent evaluations were obtained for each component. Two independent evaluations were obtained for the parts.

⁷Henry Solomon, Joseph P. Fennell and Marvin Denicoff, A Method For Determining the Military Worth of Spare Parts, The George Washington University Logistics Research Project, Serial T-82/58, April, 1958, p. ii.

The questionnaire included a statement of a typical wartime patrol for a submarine of the TIRU class. The most significant aspect of the mission statement was a requirement that the submarine stay on station independent of supply support for a period of sixty days. Sixty days was recommended by submariners as the limit of a wartime patrol for a fleet type boat, the outside limit established in consideration of the bounds placed on the endurance of the vessel by food, fuel, ammunition, and personnel morale. The mission requirement of sixty days of independent operation, in itself, provides a measurement of the seriousness of part shortages. Shortages are more or less serious depending on the capability of the ship to stay on station sixty days without repair. More simply put, if the ship can perform effectively for sixty days without the part, then the shortage of such a part is not particularly serious, and the military worth of the part is relatively low.

It is important that the answers provided not be taken out of context. There was no intention, in the answers given to the questionnaires, that the data be used to draw conclusions on the value of having any individual component aboard the submarine. The study, therefore, carries no implication of evidence on the total number of components which a submarine should have. For example, the motion picture projector was placed in the lowest Mission Effect category, but by no means supports the conclusion that submarines should not have projectors. The purpose of the study was to develop a military worth measure for use in allowance list area. Its goal, initially, is to improve the Navy's capability for providing allowance lists which maximize the endurance of vessels in consideration of space and budgetary limitations.⁸

The two important conclusions reached by the study were that first, there was a high amount of agreement (92.4%) among the independent answers responding to the questionnaires; and second, that the components classified in the highest worth category were 29.5% in the Mechanical and Electrical component classification, 0% in Electronics, 29% in the Ordnance classification and 0% in the Equipage and Portable classification.⁹ The study group concluded that the questionnaire methodology could be successfully applied in solving questions of military worth of shipboard components

⁸Ibid., pp. ii-iii.

⁹Ibid., p. 52.

and repair parts. Shipboard allowance lists would be improved by including military worth decisions in allowance list construction and even wider applications of these decisions could be made in the areas of procurement and distribution, provisioning, determination of system stock levels, disposal decisions and in the preparation of critical item lists.

If military worth was assigned to each allowance list component and repair part, then a model could be constructed by operations research oriented personnel. This model could exclude the frequency of demand variable required in an EOQ model and could be constructed to include such variables as the number of parts to be stocked, the relative weight of each item (Military Worth), all subject to the constraints of space and funding. When this concept was first announced, enthusiasm for it ran high in the Navy.

The interest in military worth was translated to implementation in allowance list construction of the Polaris equipped Fleet Ballistic Submarines, (SSBN). The vital nature of mission accomplishment required of these submarines could not be jeopardized by any deficiency in on-board repair parts. The allowance lists for these submarines required them to provide dependable support without question. The decision was made to construct SSBN allowance lists assigning military worth weights to the installed equipments, components and repair parts. The techniques utilized for accomplishing this task were developed by The George Washington University Logistics Research Project under contract to the Office of Naval

Research.¹⁰ The relative military worth of an item was depicted by an assigned numerical code. This code was named the Military Essentiality Code (MEC) and was assigned on the basis of a multi-weighted evaluation. To simplify the coding essentiality decisions were required in three areas: Mission or Equipment Effect, Redundancy and Alternatives. Within each of these basic areas a numerical weight was assigned to measure the degree of effect on a mission due to an equipment failure. Did the equipment failure cause total, partial or complete degradation of the mission? These three segments of Mission Effect were assigned a numerical weight. Similarly, a component failure was measured in terms of total, partial or complete degradation of an equipment with numerical weight assigned to each segment. In the second basic area Redundancy was weighted numerically according to the number of similar equipments installed in the ship. The third basic area of Alternatives was weighted. The nature of the degree of degradation was measured within each basic area as follows:

- | | |
|-------------------------------------|--|
| A. Mission Effect:
(IF ALL FAIL) | Total Degradation (2)
Partial Degradation (1)
Minimal Degradation (0) |
| B. Redundancy:
(IF ONE FAILS) | No Redundancy (2)
Reduced Effectiveness (1)
Equivalent Effectiveness (0) |
| C. Alternatives:
(IF ONE FAILS) | No Alternatives (2)
Reduced Effectiveness (1)
Equivalent Effectiveness (0) ¹¹ |

¹⁰ Marvin Denicoff, et. al, The Polaris Military Essentiality System, The George Washington University Logistics Research Project, Serial T-143, (Revised), January 10, 1963.

¹¹ Ibid.

In the event of an equipment failure the Military Essentiality Code of the equipment was based on the combination of the effect on the ship's mission as the above weights indicate. A combination of (2), (2), (2) would place the equipment in the highest essentiality code. In the Polaris allowance list coding this additional factor was introduced and weighted accordingly. The nature of degradation was measured in terms of Mission Effect pinpointing the nature or type of degradation, i.e., Accuracy, Reliability and Efficiency. The total MEC codes numbered 116.¹²

The success of this program was proved when the SSBN's commenced their long patrols. Allowance list support built on the MEC concept proved far superior in respect to the number of repair part deficiencies arising during the long deployment. Equipment and component failure due to lack of on-board repair parts was far lower than in any other ship type in the Navy. As a result, it was felt that this improved self-sufficiency should then be accomplished by all the fleet.

The MEC program in the entire fleet was implemented by the Chief of Naval Operations. It was to be a do-it-yourself operation, with all steps from the coding to decision making to be made at the shipboard level. In the SSBN allowance list coding many of the essentiality decisions had been made by engineering and design personnel. It was not feasible, however, to accomplish fleet-wide MEC with similar technical assistance. The philosophy for this program was that the ship's company was better equipped to make essentiality judgments than any other echelon

¹²Ibid.

in the Navy. The implementing instruction met with resistance and misgivings throughout the fleet. These will be discussed in detail in Chapter IV. Nevertheless, an order is an order and it was carried out. It fell to the Type Commander actually to implement the MEC program in his respective ships. The basic guidelines laid down by the Chief of Naval Operations were not clear cut. The system of coding was similar to the Polaris program but greatly simplified. The three basic areas were the same with a change in numerical weights:

A. Mission Effect (IF ALL FAIL)	Total Degradation (3) Partial Degradation (2) Minimal Degradation (1)
B. Redundancy (IF ONE FAILS)	No Redundancy (3) Reduced Effectiveness (2) Equivalent Effectiveness (1)
C. Alternatives (IF ONE FAILS)	No Alternatives (3) Reduced Effectiveness (2) Equivalent Effectiveness (1)

The combination of (3), (3), (3) would produce a MEC of 1. There were only 27 MEC codes in this program. Additionally, components would be assigned the same code as the equipment they supported. In the Polaris program components had been evaluated individually. The judgements required now were greatly reduced from those required in the Polaris program.

The implementing directive required that a test of this coding procedure be conducted and that the results of the test would be evaluated prior to fleet-wide coding. The Type Commanders under guidance from the Fleet Commanders conducted test coding of selected ships. Prior to actual commencement of coding in the selected ships an intensive procedure and

policy conference was required. The ships selected were normally of the same type built to the same plans and specifications. The ship's company was required to make the judgements and assign the coding. These personnel had to be informed of the purpose and benefits of the MEC to their ship. They had to be convinced of these benefits before procedures could be agreed upon. There was a great deal of conflict as to definition. An example was the feeling of ship's company that the basic area of alternatives could include jury-rigging or ingenuity. The Type Commander's representatives were required to define alternatives. In most cases jury-rigging was not an acceptable alternative within the MEC program. There were countless policy decisions of this nature required prior to commencement. The physical attack on the problem had to be outlined. Equipments listed in the COSAL had to be aligned with actual ship's plans to ensure that entire systems were included in the coding. These conferences usually required two full days before the ships could commence the coding.

The MEC program was classified top priority in terms of time allowed for accomplishment. The test ships still required in-excess of sixty days to complete the coding. The results of the coding of two ships of the same type in one Type Command¹³ indicated MEC agreement in only 24 per cent of the equipments. Similar or less correlation between test ships was discovered in other Type Commands. The MEC program, as such, never became implemented on a fleet-wide basis.

The failure of this attempt at fleet-wide MEC of ship's COSAL

¹³Test conducted by Commander Amphibious Force, U. S. Pacific Fleet.

led to one less publicized attempt to apply this technique to shipboard allowance lists. The shipboard level coding had been unsuccessful, so why not attempt to code allowance lists with the aid of an independent contractor? The philosophy behind the new coding was changed from the previous MEC attempt. Instead of treating a single equipment as an independent unit it was deemed more realistic by the contractor to consider the equipment in combination with other equipments, and mission accomplishment as dependent upon the interrelation of these combinations. In effect a ship's mission was related to system performance. A destroyer, for example, may have three or four primary missions and its readiness should be related to the capability of performing these missions. As an example, it can be assumed that a destroyer is assigned the primary mission to perform the Anti-Submarine Warfare (ASW) underwater target mission. It can also be assumed that this primary mission is related to five systems as follows:

- S₁ Mobility
- S₂ Target Detection and Location
- S₃ Weapon Delivery
- S₄ Communications
- S₅ Personnel Support

Formally stated, readiness to perform the ASW mission is dependent upon (is a function of) the performance of the systems:

$$RASW = F(S_1, S_2, S_3, S_4, S_5)^{14}$$

¹⁴Cdr. H. F. Mills, SC, USN, "Military Essentiality," Newsletter, Magazine of the U. S. Navy Supply Corps, XXVI, No. 3, March 1963, p. 4.

If this functional relationship is translated into plain language it means that the commanding officer of a ship must be concerned about the state of readiness of all the shipboard systems considered together. This philosophy of system combinations in support of readiness was translated into indices that portrayed the degradation of a ship's system in terms of mission degradation. This program was named Military Essentiality Through Readiness Indices (METRI). A few test ships were analyzed by the contractor and indices constructed for them. Fleet-wide accomplishment has not occurred and although future implementation is not impossible it is highly improbable.

Summary

The major programs implemented by the Navy in an effort to improve Inventory Management of Shipboard Material prior to August 1964 have been discussed as follows:

Coordinated Shipboard Allowance List (COSAL). The state of shipboard allowance lists at the end of World War II was one of confusion and disregard. The up-keep during the war had caused the allowance lists to become out-dated and inaccurate. The ship's allowance list did not reflect proper support for installed shipboard equipments. In addition the four different allowance lists, i.e., Machinery and Electrical, Electronics, Ordnance and Aviation, were prepared by different Technical Bureaus using varied formats and philosophies. Allowance list items were identified by Manufacturers Part Number or by the Standard Navy Stock Number.

The Bureau of Ships had been developing a new allowance list that would be prepared in the same format and include the allowance list requirements of all Technical Bureaus. The advent of the Federal Stock Number gave impetus to the implementation of the new allowance list due to the required changes made necessary by conversion to FSN. A concurrent program translated the Standard Navy Stock Number to a FSN and also produced the first shipboard allowance list in the new coordinated format. This new allowance list was designated the Coordinated Shipboard Allowance List (COSAL) and included the allowance lists of all the Technical Bureaus in the same format. The COSAL consisted of three parts: Part I was divided into three indices by allowance parts list component identification numbers, an alphabetical listing by nomenclature and sequential listing of service applications. Part II is a sequential listing by component identification number. Part III is a stock number sequence listing. The COSAL facilitated identification and control of shipboard inventories.

The Supply Operations Assistance Program (SOAP). This program was instituted to assure accuracy of COSAL support. It had long been realized that allowance lists in general and the COSAL in particular were not kept current and therefore did not reflect proper support for shipboard equipment. The SOAP program was implemented to aid the ship in validating the accuracy of its COSAL. This validation and updating of ship's inventory was accomplished during the regular maintenance overhaul period. Ship's personnel actually moved repair parts to SOAP team facilities and conducted

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a complete inventory of the material. The material was identified if necessary and stock numbers were up-dated as required. The results of this program included Excess and Deficiency Listings, Frequency of Demand Listings and what is even more important -- improved reliability in shipboard equipment support. The SOAP program originally generated much displeasure but after an education program instituted by Type Commanders has grown to be an accepted and integral part of inventory management of shipboard material.

Military Essentiality Coding (MEC). The advent of operations research stimulated Navy inventory managers to investigate the construction of inventory models that could optimize shipboard inventories without the variable factor of predicted demand. Since the demand factor was an unknown factor it was believed that a more reliable allowance list could be constructed if each equipment, component and repair part were assigned a relative importance. The relative importance was actually the military worth of an item in regard to the effect its absence had on mission completion. The first allowance lists constructed on the basis of military worth were the Fleet Ballistic Submarines COSAL's. The effect of equipment, component or part availability was considered to weigh the military essentiality of the item in relation to its effect on the ship's mission accomplishment. The COSAL was prepared and a Military Essentiality Code was assigned to each allowance list item. The success of this coding stimulated the Navy to implement MEC on a fleet-wide basis. A pilot program was instituted but did not achieve the expected results. The implementation of this particular MEC was never completed.

The assigning of Military Essentiality was attempted using a different technique and philosophy. The interrelation of shipboard systems was compiled in terms of a series of readiness indices. This program was accomplished by a contractor and indices were constructed for a few ships. This program was known as Military Essentiality Through Readiness Indices (METRI).

CHAPTER III

MAJOR PROGRAMS AFTER AUGUST, 1964

Supply Support of the Operating Forces

On 27 August 1964, the Chief of Naval Operations prescribed a Supply Support Policy for the entire fleet. This section is devoted to an analysis of this policy and all quotations are taken from this instruction.¹

The area of shipboard inventories and the policies concerning their parameters had never been consolidated into one standard doctrine. The policies and procedures involved had varied between Atlantic and Pacific Fleets, and within the respective fleets various standards and guidelines differed between Type Commanders in the same fleet. It was within this environment of individuality that shipboard material management had evolved. The basic objective of this Supply Support Policy was to ensure standard guidelines and terminology throughout the fleet in regard to shipboard material readiness. This definitive policy has cleared the air and caused a revolution, in that all efforts in improving the reliability of shipboard support are now channeled down the same path and are not pulling in the many directions they had previously travelled.

¹Department of the Navy, Office of the Chief of Naval Operations, Supply Support of the Operating Forces, OPNAV Instruction 4441.12, August 27, 1964.

The purpose of this CNO Instruction was to set forth the basic

Navy policy governing:

. . . the determination of fleet material requirements, fleet asset distribution, and prescribe the shipboard endurance necessary to achieve the desired standards of logistic readiness and endurance of the Operating Forces.

The concept on which this Supply Support Policy was based was that:

Under combat conditions the only assured supply to the fleet may be limited to the material carried by individual ships, the mobile logistic support forces and positioned at overseas bases. The total resources carried in individual ships and in mobile logistic support forces will consist of allowance list and load list material required for naval operations in support of the national policy for the period specified by the Navy Support Plan (Navy mid-range plan).

Although the Supply Support Policy encompasses the entire supply system it will be examined as to its effect on the first echelon of supply which includes individual shipboard allowance lists that are stocked to sustain independent operations for a pre-determined period without external support.

The policy defines the second echelon of supply as:

. . . the industrial and resupply material positioned in the mobile logistic support force and the resupply material positioned at designated bases in support of actual and planned fleet deployment for a stated period without augmentation.

In the first echelon of supply the range and depth of material to be carried is clearly stated in terms of days of endurance.

<u>Hull Type</u>	<u>Repair Parts and Equipment Related Consumables</u>	<u>Non-equipment related Consumables & Provisions</u>
Ships larger than DD	90 days	90 days
DD and Smaller	90 days	45 days
Submarines	90 days	90 days

Amphibious Units:

Ships Complements

90 days

90 days

Embarked Troops

Not Applicable

60 days

Non-self-sustaining Ships

(Landing Craft, etc.)

As Required to Accomplish Assigned Mission

The second echelon of supply was in turn established to support combat endurance levels of 90 days for all material. Reliance for support was to be placed on the afloat capabilities of the fleet, using advanced support bases only when mobile support required supplementation. The Policy spelled out the action required by the various echelons in implementation of this doctrine. The Chief of Naval Material was charged with coordinating the development of shipboard allowance lists that would include Military Essentiality Codes and also would be capable of identifying allowance list items by category, i.e., equipment, equiptage, repair parts and consumables. He was to evaluate supply effectiveness of overall Fleet Supply Support and take appropriate action to correct deficiencies. The establishment of criteria for the selection of high value, critical or limited application items to be distributed to each fleet on a restricted basis was under his cognizance. In addition the Chief of Naval Material would continue to provide program management and support to the Supply Operation Assistance Program (SOAP).

The Fleet Commanders were directed to utilize shipboard allowance lists as the basic stocking authority at the shipboard level and were given the authority to authorize excess of allowance loading of ships for operations where the mobile logistic support forces or other means of replenishment were not available. They were to police the utilization,

maintenance, and validation of allowance lists and take corrective action where required. The Fleet Commander was to provide support requirements to the Chief of Naval Material for utilization in allowance list preparation. In this regard they were required to institute a data collection system including usage and demand data gathered from fleet units that would assist in allowance list preparation and update.

The Chief of Naval Operations directed the Fleet Commanders to enforce allowance list discipline to ensure that authorized levels of shipboard stock were not exceeded. They were to continue to conduct the Supply Operations Assistance Program (SOAP) and advise the Chief of Naval Material as to the adequacy of fleet support.

The Criteria for Shipboard Allowances were spelled out: The first criterion defined the content of shipboard allowance lists. Allowance lists would describe and establish allowed quantities of equipment, components, equipage and repair parts and other materials required in the direct support of the ship to ensure its self-sufficiency (equipment related consumables). The material described in shipboard allowances represented the First Echelon of Supply. The second and most important criterion stated:

Shipboard allowance lists are mandatory as to range and depth of stock carried. Existing directives which conflict with this policy will be revised.

The various policies of Type Commanders were cancelled by this explicit statement. There could no longer be any known allowance list deficiencies on board a ship and this in turn stressed the importance of an accurate and up-to-date COSAL. For the first time the shipboard allowance list was

recognized as a document of stature that could no longer be looked upon with casual concern. This was a milestone in the history of shipboard inventory management. This policy was given limited leeway by the third criterion which allowed ships to load material in-excess of their allowance lists only with approval of the cognizant Type Commander or in his absence by the Senior officer Present Afloat (SOPA). These approvals would be valid for an interim period and if long range planning required these in-excess materials would be added to the ship's allowance list. If an allowance change were considered necessary the proposed change was to be submitted by the originating ship to the cognizant Technical Bureau, via the Type Commander, with a copy to the appropriate inventory manager. The statement of Criteria for Shipboard Allowances further required that the allowance of repairs parts and other directly supporting equipment related consumables would be stored under the bin-drawer concept. This had the effect of requiring all ships to adopt the central storeroom concept of shipboard supply. Under this concept all allowance list material was kept under the custody and control of the ship's Supply Officer. In the past only larger ships had been required to use central storeroom procedures; now every ship in the fleet would be required to adopt this system. Additionally, the criteria made clear that shipboard allowance lists would be responsive to changes in demand resulting from approved data collection programs and, as a minimum, shipboard allowances would be reviewed and revised at the time of maintenance overhaul. These revisions would reflect the most accurate demand or usage experience available to the allowance preparing activities. In view of this requirement the Supply Operations Assistance Program would be continued concurrently with shipyard overhauls to refine inventories,

up-date inventory records and identify material deficiencies and/or excesses.

Application of the criteria was extended to the development of shipboard allowance lists. Demand Based Items were those items having a predicted usage of at least one unit in 90 days for all installations aboard ship. Demand Based Items and Equipment Related Consumables meeting this usage criterion had to be stocked in such a manner as to achieve stock effectiveness, the filling of on-board demands, of at least 90 per cent for a period of 90 days. This stock level was to be predicted on the combat consumption rates whenever such rates could be ascertained. As a rule of thumb the combat consumption rate for most items was one and one-half the normal consumption rate. Insurance Items were those items which do not have a predicted usage on board ship of at least one unit in 90 days. Only those Insurance Items considered vital to the support of a ship's primary mission (s), or to the safety and welfare of shipboard personnel would be included in the allowance list. These vital Insurance Items would be allowed to a minimum depth, either unity or a minimum replacement unit. Insurance Items not included above and with no usage reflected for a period of two years would be eliminated from shipboard allowance lists. This stringent constraint on Insurance Items would greatly reduce their number in shipboard stock over the next few years.²

In the future, shipboard allowance lists would be coded to identify items of equipment, equipage, repair parts or equipment related consumables and also indicate the degree of management control required aboard ship, i.e., inventory frequency and custody signature requirements. Shipboard

²Supra, p. 6.

allowance lists would also be coded to reflect the military essentiality of each item.

The Supply Support Policy of the Operating Forces laid the first fleetwide foundation, in definitive terms, for the building of an integrated Navy wide system of shipboard inventory management. The policy has been the springboard for many important programs that, in the end, will achieve the objective of optimization of shipboard inventories.

Interim Programs

Fleet Logistics Support Improvement Program (FLSIP). This program was established in August 1964 to resolve the problem of maintaining a balanced ready Naval Force capable of performing assigned missions in the face of steadily increasing costs resulting from technological advances and the use of more costly sophisticated systems. Under the FLSIP program, the duty of the Chief of Naval Material was to coordinate the development of new allowance lists that would reflect the Supply Support Criteria of the Chief of Naval Operation's Supply Support Policy. The Chief of Naval Material directed the technical bureaus (now renamed and hereafter referred to as material bureaus) to initiate implementation of this program. FLSIP's ultimate objective was the publishing of shipboard allowance lists which reflect the Supply Support Criteria.

Under the FLSIP program, Military Essentiality Codes will be assigned to every installed equipment/component. This MEC will define the importance of the item in relation to the mission of the ship. The development of the MEC at the equipment/component to ship level will be accomplished

by the Bureau of Ships, the Bureau of Weapons (a consolidation of the Bureaus of Air and Ordnance) and the Fleet. The processing, incorporation into computer records and dissemination of information to the fleet will be accomplished by the Bureau of Supplies and Accounts. The Allowance Parts Lists (APL) will be developed to include the following information relating to the maintenance policies of the Bureau of Ships and the Bureau of Weapons:

- (1) MEC of the part to the equipment or component.
- (2) A Maintenance Code which defines the level at which maintenance is to be performed, i.e., Ship, Tender, Shore Activity.
- (3) The minimum replacement unit, i.e., each set.
- (4) The planned maintenance requirement.

To achieve this objective of the FLSIP will require the development and recording of 14 million individual part level decisions covering 205,000 different APL's.³ In view of the huge scope of this decision making process the Bureau of Supplies and Accounts intends to follow a Lead-Follow concept. In excess of 3000 Lead APL's will be constructed covering generic groupings of equipments. These LEAD APL's will be distributed to the Bureau of Ships managed activities (Naval Shipyards) who will define the maintenance policy in terms of the four elements cited above. These decisions will be analysed manually and translated by the Ships Part Control Center to all applicable future APL's.

Military Essentiality Codes are to be obtained at the equipment to

³Data extracted from Bureau of Supplies and Accounts Program Change Proposal, submitted on February 25, 1965, Tab B, p. 3.

component to ship's hull level. Approximately 800 COSAL Indices, one for each hull, have been provided by the cognizant Inventory Control Points (Inventory Managers) to selected Bureau of Ships and Bureau of Weapons managed activities. The aim of these activities is to assign vital or non-vital decisions to each equipment or component listed in the indices according to their essentiality to the primary mission of each ship as specified in the Supply Support Policy. At the conclusion of this coding process, a joint Bureau/Type Commander review of the military essentiality determinations will be made. The Chief of Naval Operations will participate in this review, on an exception basis, to resolve differences of opinion. The approved hull indices will then be forwarded to the Inventory Control Points where MEC (vital, non-vital) decisions will be keypunched and entered into magnetic tape records as one of the additional data elements required in the preparation of the new COSAL's.

The completion of FLSIP was scheduled in Fiscal Year 1966. It is doubtful that completion will be on schedule but the program and its inherent benefit in terms of improved shipboard allowance lists and material management will be available to the fleet in the near future. FLSIP is the most elaborate and comprehensive of the interim programs. However, it alone could not accomplish all the goals and objectives set forth in the Supply Support Policy.

High Value Accounting System (HIVAC). In compliance with the Supply Support Policy, the Chief of Naval Material directed the Bureau of Supplies and Accounts to establish criteria for the selection of high value, critical

or limited application items to be given restricted distribution in support of each fleet. There had been little or no usage or demand data generated or accumulated to reflect stock movement of high value items. Therefore, the Bureau of Supplies and Accounts directed the Inventory Managers to prepare a listing of high value items under their cognizance. The value of an included item was in general about 500 dollars or more. These listings were prepared and distributed to the fleet. The ships were required to make a one time inventory of their stock and report the quantities of high value items that were in their storerooms. They were then required to make monthly reports to the cognizant Inventory Managers on the issue of any high value item. This was the beginning of a usage accumulation of high value items and will be the basis for forthcoming stocking policies for these items.

Deficiencies In Allowance Lists (DIAL). The importance of budgetary considerations cannot be overemphasized in any discussion of shipboard inventory management. The Fleet Commanders have complained to the budgeting echelons within the Department of Defense that they have not been allowed sufficient funds with which to procure shipboard inventories. Prior to the Support Policy the Navy had not been able to justify increased funding for procurement of shipboard material. The lack of data reflecting inventory value, demand and usage data reduced these requests for increased funds to an emotional plea. Under the Department of Defense's programmed budget concept, emotion was not enough to win an increase in funds. The forthcoming implementation of the Support Policy would not produce the

required factual data required to support increased funding requests for at least two years. In the interim the ship's allowances were deficient in many aspects. These deficiencies were discussed in general but there was no consolidation in the Navy of the exact quantity and cost of these deficiencies.

The Chief of Naval Operations implemented a one time "crash" program. It requested that all Navy ships prepare and submit requisitions for all allowance list deficiencies. This was the Deficiency in Allowance List Program known as DIAL. The ships were given only two weeks to prepare their DIAL requisitions and then the requisitions were submitted to selected supply activities for compilation. The result of the DIAL program was that for the first time all deficiencies in shipboard allowances were known and, in effect, on order. The only stumbling block was the lack of funds required to procure the material. The hard-core data available to the Chief of Naval Operations was used in acquiring an increase in funds, although not sufficient to procure all deficiencies, enabling a partial procurement of the shipboard deficiencies. The increase in funding was proportionately allocated to the Type Commanders and they in turn decided on what allowance deficiencies their ships could procure.

The Three "S" Programs (SOAP, SAVE, SHIR). The Supply Operations Assistance Program is by no means an interim program. It is included in this section only because it has fathered two interim programs that may someday become as permanent as their parent.

SOAP records pertain to a program of periodic supply overhauls for every Navy ship. Through SOAP, storeroom inventories of repair parts are

brought up to the level of material readiness prescribed by the Chief of Naval Operations. During supply overhauls, ships turn in excess parts and requisition other parts to fill deficiencies. Under this procedure, many requisitions for deficient parts result in charges to the Type Commanders' allotments, while many turn-ins generate a credit to the same allotments. Many times a ship of the Type Command is requisitioning deficiencies that are chargeable while concurrently a sister ship under the same Type Command is turning in excesses that the first one is ordering. This places an unnecessary drain on the Type Commander's already stringent funds.

The Shortages and valuable Excesses (SAVE) program is designed to remedy this situation. Since SOAP determines deficient and excess supply quantities for each ship, it is a natural step to compile selected data into a master SAVE file of deficiencies for screening against the excesses as they are generated. This permits a redistribution of excess parts among ships to satisfy the shortages of the same items in other ships of the same Type Command. The funds are no longer wasted in unnecessary procurement.

The Ship's History and Inventory Record (SHIR) program will receive information gathered as a by-product of the SOAP/SAVE programs. Navy inventory managers have been directed to commence SHIR files, which will include allowance, inventory and usage figures for each repair part in a ship's allowance. The SHIR data will aid the inventory managers in budget planning and fleetwide control of repair part support.⁴

⁴ "3 'S' Program," The Pacific Supply Letter, published monthly by C in C Pacific Fleet, No. 254, November 1965, p. 5.

Afloat Supply Information System. Among his responsibilities, the Fleet Commander is required by the Supply Support Policy to implement a usage and demand data collecting system from fleet units to be used in the preparation of allowance lists.

The Afloat Supply Information System was developed jointly by Commanders of the Service Forces of the Atlantic and Pacific Fleets. Acting as logistic agents for their respective Fleet Commanders, they agreed upon this system that will require ships to submit all copies of their consumption documents, Budget Reports and Quarterly Supply Status Reports to a data processing activity. These documents will be processed by the computer and the output will be used by the Type Commanders to measure the supply readiness and effectiveness of an individual ship. With this data, the Type Commander can more effectively allocate funds by having available current consumption rates and up-to-date deficiency information. The availability of this data will enable the Type Commander to prepare more meaningful budgets. The ships will receive summarizing reports of their consumption and spending rates in comparison with other ships of their type. This system was implemented on 25 Pacific and 25 Atlantic Fleet Destroyer Type Ships on a trial basis. The trial period concluded on December 31, 1965 and the success or failure of this system will depend on the results achieved. If successful, this system will become a permanent program.⁵

The programs described in this section are the major interim

⁵Pacific Briefs, "Afloat Supply Information System," Navy Supply Corps Newsletter, XXVIII, No. 11, November 1965, p. 26.

programs implemented to achieve the objectives set forth in the Supply Support Policy. These programs are the most prominent but are by no means inclusive of all such interim programs. Many "one-shot" programs are being implemented by varying echelons in the Navy that are required to accumulate a basic data base from which the Optimum Allowance List can be built.

Program Objectives

The Optimum COSAL. The Supply Support Policy and the programs that it has spawned are all directed toward improving the material readiness of Navy ships at sea. The major programs previously described are a means of gathering input in order to provide an output that will enable the Navy to construct an Optimum COSAL.

The format of the Optimum COSAL will be similar to that of the present edition. The Optimum COSAL will be divided into three parts. Part I is the Index and in addition to the three sections will have an MEC for each Equipment and Component. Part II, the Allowance Parts List (APL's) will, in addition to the present data portrayed, have a maintenance code, a part MEC, a minimum replacement unit and a planned maintenance requirement. Part III, the Stock Number Sequence Listing, will include the FSN or Manufacturer's Part Number, the item name, the Component Identification Numbers (CID's) applicable, notes, unit of issue, allowed quantity, total ship's population per CID number, MEC, supply management codes, custody code, unit price, credit code (for turn-in value), and unit cube.

In order to include all this information and to assure continued allowance list accuracy, a continuous flow of input data reflecting demand and usage characteristics must be available. The Supply Support Policy has directed that all echelons in the operational and logistic chain of command institute cogent data collection systems. This is being accomplished. The ability to review comprehensive data prior to procurement of repair parts will enable the supply system to more accurately choose between existing alternatives and ensure that the system can support the demands of the fleet. The more accurate demand characteristics available will lend themselves to application of more sophisticated inventory control techniques. Techniques such as the probability theory applied to inventory control⁶ can be more easily utilized by the Navy Supply System to optimize system support of fleet demands. The techniques employed in operations research to construct inventory models, dynamic models under conditions of certainty, such as the Optimal Policy Curve⁷ can now be used to improve access of the inventory managers to the data describing the variables of the shipboard inventory problems.

The policies and criteria laid down by the Chief of Naval Operations in the Supply Support of the Operating Forces will undoubtedly improve the status of shipboard material support. The problems to be solved in determination of on-board repair parts are being solved. The six

⁶Edward W. Smykay, Donald J. Bowersox, Frank H. Mossman, Physical Distribution Management (New York: The Macmillan Company, 1961), p. 98.

⁷Martin K. Starr and David W. Miller, Inventory Control: Theory and Practice (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1962), p. 93.

major problems in this area were enumerated by Rear Admiral H. J. Goldberg, Chief of the Bureau of Supplies and Accounts, in a speech delivered November 15, 1965 to the Pentagon Shipbuilding Study Group. These problems were outlined thus:

1. Timely and Complete Component Identification. Pretty clearly, on-board parts determinations should be completed well before the ship has completed construction -- so that time is allowed for documentation of all the decisions and delivery of documentation to the ship and so that stowage and arrangement of repair parts on-board can be accomplished before the ship sails. Also, if all of the inputs to the repair parts determination are to be developed on time, installed or to be installed components must be precisely identified and described in detail long before the repair parts determination.

For numbers of reasons, chief of which is the way we build and plan the building of ships, it does not happen that way. Even in the case of the Polaris Submarines, this input is always incomplete when the subs go to sea lacking supporting repair parts which should be on-board. We look forward hopefully to the FDL's.⁸

The Fast Deployment Logistic Ship (FDL) is the first ship to be designed, contracted and constructed on a "package concept." The Department of Defense decided to procure 10 of these ships under the same procurement concept as applied to aircraft. The manufacturer awarded the contract is responsible for the entire construction of the ship and is also required to provide repair part support for a period of years under the contract. This coordinates and consolidates the ship and its support into a "package" that should eliminate the problem of timely and complete component identification.

⁸ Rear Admiral H. J. Goldberg, SC, USN, Combatant Ships On-Board Repair Parts, Navy Department, Chief, Bureau of Supplies and Accounts, Speech Delivered to the Shipbuilding Study Group, Pentagon, November 15, 1965, p. 73.

2. Component Standardization, Within and Among Ships. Let me simply state that, in the past and for the most part, each separate hull has represented a prototype as viewed from our hull to component files. In the case of Hull, Mechanical and Electrical Components installed in our ships, we are supporting 175,000 distinct components. About 23% of them have an installed population of one, i.e., in only one ship. An additional 41% have an installed population between 2 and 9, and 36% have a population of 10 or greater. In the case of on-board repair parts determinations, this situation represents a problem because with each new hull we start largely from scratch in building the automated files. And of course this also means more different repair parts to manage -- to store on-board -- and to finance! As an aside, but possibly more of a problem, you can well imagine the little back-up support we can afford to lay down ashore for components of small fleet population, particularly when most repair parts are infrequently required. Again, we look forward to the FDL's.⁹

The third problem is directly related to problem 2.

3. Demand Pattern for Ships Repair Parts. The infrequency of demand for most component repair parts represents a problem, all by itself. Because of this fact of life, budget reviewers know that as few as fifteen to twenty per cent of a given ship's on-board repair parts range will be used between overhauls. The trick, of course, is to know what fifteen per cent will be used on what deployment. But the picture makes reviewers loath to give the fleets sufficient funds to maintain their allowance of repair parts. The picture makes the reviewers even more loath to grant funds for even limited shoreside, back-up stocks of such items. Hence, more and more when the ships need such a part which they haven't been able to maintain on-board, it is not in shore stocks, either!¹⁰

4. Sophisticated, Untested and Unstable Equipments. Another way to state the fourth problem area is 'we seem always to lead the state of technological art in our demand for better equipment capability on-board ship.' The only way other to state it would be to say that we do not make our contractors deliver reliable equipments -- most of them are still in development and with unreliable components when we install and start supporting them. As a consequence, we are unable to estimate reasonable parts replacement rates for the first configurations and unable to keep up with the alteration fixes as they are accomplished, one upon the other.¹¹

⁹Ibid., p. 76.

¹⁰Ibid., p. 77.

¹¹Ibid., p. 78.

This is a plea for installing only those equipments that are thoroughly tested and proven in Navy ships.

5. Qualified Maintenance Personnel. I raise the problem, perhaps redundantly, because it frequently is masked as a problem of on-board or back-up repair parts shortages. Maintenance plans and replacement factors are premised upon availability of qualified personnel. The premise too often is a bad one.¹²

The sixth problem delineated by Rear Admiral Goldberg is actually a measurement of the progress of the Bureau of Supplies and Accounts in implementing their tasks as defined in the Basic Supply Support Policy.

6. Coverage for Specific Inputs to the Determination Process. For all ships and for all types of components, we are still up to two years away from being supplied by the responsible engineering authorities, the necessary special technical inputs, particularly Military Essentiality and Maintenance Codes We expect to get there!¹³

The problems of shipboard inventory management today are the same as in the past. Today, however, and in the near future these problems can and shall be solved. The concern and interest in the state of material readiness in terms of on-board supply support is no longer a "supply problem" -- it is a Navy problem. The realization of the scope of the problem has opened the resource flood gates of the entire Navy and directed attention and action on solving the problem of optimization of shipboard resources.

Summary

The issuance of the doctrine of Supply Support of the Operating Forces by the Chief of Naval Operations in August of 1964 was a milestone

¹²Ibid., p. 80.

¹³Ibid., p. 81.

in coordinated policy statement concerning shipboard material support. This support policy clearly stated policies and criteria for Navy-wide compliance in implementing standardized programs to improve shipboard material readiness. Prior to the issuance of this policy, guidelines and criteria concerning shipboard allowances and their management varied between Atlantic and Pacific Fleets and within respective fleets with specific Type Command doctrine. Fleet-wide endurance levels were clearly stated in days and were applicable in all instances. The COSAL was specified as a mandatory document. Allowance list limits could only be changed by the Type Commander and then only on an interim basis. The Chief of Naval Material and the Type Commanders under the Fleet Commanders were assigned tasks and the entire Navy was coordinated in improving the state of shipboard material readiness.

In compliance with the policy, the various echelons within the Naval establishment embarked on interim programs to accomplish the requirements laid down by the Chief of Naval Operations. The Fleet Logistics Improvement Program (FLSIP) was the most important of these programs. The duty of the Chief of Naval Material under the FLSIP was to coordinate the development of new allowance lists that would reflect the Supply Support Criteria. The High Value Accounting System (HIVAC), the Deficiencies in Allowance Lists (DIAL) program and the Three "S" programs were all conceived as was the Afloat Supply Information System to aid in construction of this new allowance list.

The programs objectives were to accumulate data and establish permanent systems of informational input to make this new allowance list an Optimum COSAL.

The basic problems in ship construction, equipment procurement and implementation of the new systems will require at least two years before the primary objectives of the Supply Support Policy are achieved.

CHAPTER IV

SUMMARY AND COMMENTS

In Chapter I the parameters of the problem of inventory management of shipboard material were explored as a three part discussion. The ship in itself was a contributor to the problem due to the policies required of The Navy Department in contracting for ship construction. The practice of competitive bidding with the lowest bidder winning the contract based on performance standards has not allowed ships and their installed equipments to be standardized. This lack of standardization has increased the requirement for the supply system to carry repair parts in support of a few equipments. Within stringent budgetary constraints funds are expended on parts peculiar to one hull when optimization of system inventory could be accomplished with these funds by procurement of repair parts in support of larger populations of shipboard installations. The ship also creates a problem by its own essentiality to the overall mission of the Navy in requiring on-board stocking of repair parts that are carried only as insurance items and not because of any demand or usage criteria. These insurance items are only required occasionally and in themselves constitute the bulk of monetary investment in shipboard stock. Their turn-over rate is non-existent.

The basic policy of Navy shipboard construction prevents standardization. This policy must be changed to bring about the elimination of

support systems peculiar to individual ships. The Department of Defense, in ordering the construction of the Fast Deployment Logistic ship (FDL), has changed the construction policy. Ships of the FDL type will be procured on a "package" basis whereby the contractor is required to plan, design, construct and provide repair support for a long term period. This "package" procurement has proved successful in aircraft construction and if successful in ship construction will be instrumental in solving this part of shipboard support problem.

The ship's personnel is the second aspect of the overall problem in the operation of the informal supply system aboard ship. The formal shipboard supply system, under the cognizance of the ship's supply officer, is charged with the responsibility of maintaining shipboard inventories in accordance with the allowance list to support the ship in a state of readiness and self-sufficiency to accomplish any assigned mission. The tempo of operations during World War II and the lack of importance attached to allowance list maintenance by a ship's company found the formal shipboard supply system in a state of chaos at the end of the war. The informal supply system, always a factor in shipboard life, grew in size due to the failure of the formal system and the desire of the crew to accomplish their tasks for the good of the ship. This informal system is a series of pyramiding storerooms commencing at the individual level and progressing through departmental echelons to the department head. These storerooms contain material received from the formal system and also include material acquired on the Navy grey market by bartering coffee and other prized commodities in return for repair parts and

consumable material to be stored in the informal system. The formal system does not record the usage and demand of the informal system and when the ship is absent from the sources of supply both systems fail to produce the required repair part. Mission degradation is the result, although the intentions of all shipboard personnel were exactly the opposite.

The informal supply system in a ship can never be wholly eliminated nor should it. However, the formal supply system must be the source of supply for the informal system. Accurate records kept of all issues made to shipboard departments whether from ship's storerooms or directly from the shore establishment will reduce the harm imposed on material readiness by the informal system. The current attention and policy controls imposed on Navy ships are underlining the importance of accurate demand and usage data. The improved statistics improve the content of the allowance lists and thence the support rendered to the ship by the formal system. The improved support will bring about a lessening, by ship's personnel, of dependence on the informal system and the bartering will abate. This aspect of the overall problem can be solved and is being solved by current Navy Supply Support Doctrine.

The third aspect of the problem, that of the complexity of organization, and the flow of directives from this complex descending upon the ship in an avalanche of conflicting policies can not so easily be resolved. The requirements of the various echelons differ, therefore their logistic policies differ. A reorganization of the Navy is not feasible. However, it would not be too difficult for all directives requiring support action from a ship to be routed directly to the Type

Commands. These Type Commands could then consolidate the requirements and pass them on to the ship in one package. This would not be too difficult to accomplish.

Chapters II and III described the various major programs prior to and following the issuance of the doctrine of Supply Support of the Operating Forces by the Chief of Naval Operations in August 1964. In Chapter II the problems encountered due to the format of the shipboard allowance lists were discussed. The variance of allowance list construction by the responsible Technical Bureaus as to philosophy and format was considered a handicap to proper shipboard inventory management. A new allowance list was introduced that coordinated all the different allowance lists into one format. This was known as the Coordinated Shipboard Allowance List (COSAL). It was a major breakthrough in simplifying material management afloat. In conjunction with the COSAL the Supply Operations Assistance Program (SOAP) was implemented and this program ensured that the COSAL would accurately reflect up-to-date equipments requiring on-board support. The SOAP program is now considered an integral part of the supply support system. It is also the source of demand and usage data, shipboard excesses and shortages and provides the base necessary for continued optimum shipboard support.

The most controversial program was the Military Essentiality Coding program. The MEC was thought to be necessary to give relative weight to shipboard equipments, components and repair parts in the absence of usage data. MEC was first used in the construction of Polaris equipped submarines (SSBN) allowance lists. The success of this coding caused an effort to be implemented to code all Navy allowance lists in a similar

fashion. This MEC program was to be done at the shipboard level. An immediate resistance to the program came from the fleet. The basic fear of the MEC program by the fleet was justified. The fleet had been suffering under stringent budgetary constraints in all areas. The area of supplies and equipage was particularly vulnerable to budgetary cuts. The Navy in the past had not been able to justify their supplies and equipage requirements to the satisfaction of the Secretary of Defense. Therefore every year a little more money had been sliced from this allocation from which the material for shipboard support was purchased. The introduction of MEC appeared to be a budgetary control and not an inventory management tool. It was quite obvious to the fleet that a budgeteer could look at only the material coded as essential and fund only for that material. Under the guidelines of the MEC program only those equipments and components essential to the mission of the ship were to be given a high code. The fleet could foresee that under this program at least two-thirds of the shipboard allowance would be coded as non-essential and would be wide open to a budgetary axe. These were the conditions under which the MEC test was conducted. The results of this particular program were not definitive. The correlation between similar type ships was poor. The per cent of essential items was high. The MEC under these guidelines never proceeded to fleetwide application.

The issuance of the Navy-wide Supply Support Policy by the Chief of Naval Operations took into account all these basic problems. The doctrine established policy, endurance levels, and criteria for shipboard material. The allowance list was made a mandatory document and no longer

could be looked upon as a general guide. Endurance in terms of days was standardized Fleet-wide, although it was still not clear how a ship could calculate what quantity of a repair part could be established as a 90-day supply. Endurance levels were not clearly defined but guidance was offered in that all endurance levels were to be calculated in terms of combat consumption rates and these were generally one and one half times normal consumption rates. MEC coding was to be a way of life. The coding would be accomplished under the direction of the Technical Bureau and the code would simply indicate that the equipment was vital or non-vital to the mission of the ship. Demand Based Items were defined as were Insurance Items. Insurance Items that did not register demand in a two-year period would be removed from the allowance list unless the Insurance Item was coded vital or was vital to the safety and welfare of the ship's personnel. All echelons were directed to institute data collection systems reflecting all aspects of stock behavior and these statistics were to be coordinated with the allowance preparation activities and the cognizant inventory managers. The objective of this policy was to create an Optimum COSAL constructed to include all data pertinent to efficient and dependable Inventory Management of Shipboard Material. The Navy would eventually have a coordinated system of supply support based on up-to-date inventory management techniques and improving the material readiness of the fleet.

The completion of this objective is in sight. Upon its completion the Navy will be better equipped to support its ships over long periods of deployment and at vast distances from sources of supply. The number of

equipment failures caused by lack of on-board support material will eventually be reduced to a minimum but never to extinction. The improvements are coming and, indeed, many are already here. The future of ship-board material readiness is in good hands.

APPENDIX

GLOSSARY OF ORGANIZATIONS AND TERMS

Bureau of Ships -- A Technical Bureau (Management Bureau) responsible for planning, designing, procurement and repair part provisioning of ships and their complete installed equipments.

Bureau of Supplies and Accounts -- A Technical Bureau (Management Bureau) responsible for all facets of Inventory Control, distribution and stockage, in the Navy Supply System, of repair parts, consumables and equipage in support of installed shipboard equipments.

Bureau of Weapons -- A Technical Bureau (Management Bureau) responsible for planning, designing, procurement and repair part provisioning of aircraft and weapons systems and their complete installed equipments.

Bureau of Yards and Docks -- A Technical Bureau (Management Bureau) responsible for the management and support of Navy owned or operated Real Estate and in addition is responsible for procurement and distribution of all automotive equipment.

Chief of Naval Material -- is responsible to the Chief of Naval Operations for overall logistic (except personnel) support for the Naval Establishment. The Management Bureaus report to him.

Chief of Naval Operations -- The Senior Naval Officer, a member of the Joint Chiefs of Staff, responsible to the Secretary of the Navy for the operation and readiness of the fleet and the Naval Establishment.

Defense Supply Agency -- Responsible for the Inventory Management, procurement, stocking and distribution of repair parts, consumables, equipage, and clothing common to all branches of the Department of Defense. The Defense Supply System is composed of Inventory Managers in charge of Inventory Control Points under the Director of the Defense Supply Agency. The Director reports directly to the Secretary of Defense.

Fleet Commander -- (Titled Commander in Chief, Atlantic or Pacific Fleet) is responsible to the Chief of Naval Operations for the overall readiness of his respective fleet.

Insurance Items -- Items for which there may be occasional intermittent demands not sufficiently repetitive to warrant classification as regular stock items; but for which prudence requires that a nominal quantity be stocked for the reason that the essentiality of the items and the lead time required to obtain such items by purchase would create an unacceptable situation if no stock were carried.

Inventory Management -- is that phase of military logistics which controls the input, availability and disposal of material in the Naval Establishment.

Inventory Manager -- (Inventory Control Point) -- under the management control of the Chief, Bureau of Supplies and Accounts is assigned responsibility for the inventory management of specified items or categories of items identified by cognizance symbols. Program and supply support assignments are made jointly by the Bureau of Supplies and Accounts and the Technical Bureau having cognizance. (Examples of ICP's are: the Ship's Part Control Center, Electronic Supply Officer and the Aviation Supply Office.)

Item -- A generic term meaning any or all of the species of material. It is sometimes used with a modifier to mean a particular sub-classification. See Material.

Material -- All items necessary for the equipment, maintenance, operations and support of military activities without distinction as to their application for administrative or combat purposes. Material is a generic term which is sub-classified as follows:

1. Part (or component)
 2. Sub-assembly
 3. Assembly
 4. Equipment
 5. System
-
1. Part -- One piece, or two or more pieces joined together (a component) which are not normally subject to disassembly without destruction of designed use.
 2. Sub-Assembly -- Two or more parts which form a portion of an assembly or a unit replaceable as a whole, but having a part or component which are individually replaceable.
 3. Assembly -- A number of parts, components or sub-assemblies, or any combination thereof, joined together to perform a specific function.
 4. Equipment -- All articles of a capital nature needed to outfit an individual or a ship (organization).
 5. System -- (General) A combination of parts, components, sub-assemblies, assemblies and equipments joined together to perform a specific operational function or functions.

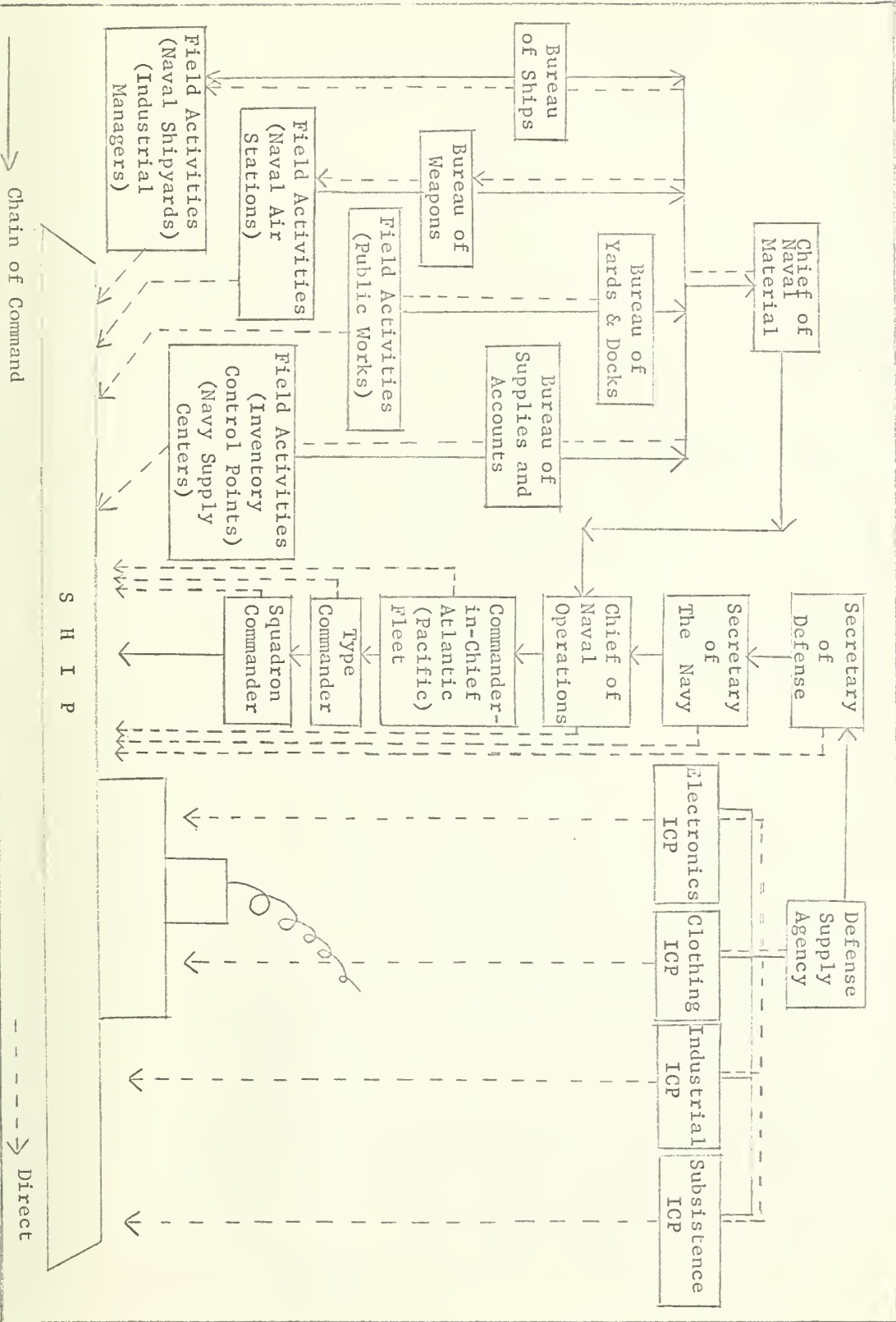
Provisioning -- is the process of determining the range and depth of items (i.e., repair parts, special tools, test equipment and other equipage and consumables) required to support and maintain an item for an initial period of service. Its phases include the identification of items of supply, the establishment of data for catalog, technical manual, and allowance list preparation, and the preparation of instructions to assure delivery of necessary support items with related end articles.

Secretary of Defense -- A member of the President's Cabinet and senior civilian in charge of the Department of Defense and responsible to the President for the overall defense posture.

Secretary of the Navy -- Responsible to the Secretary of Defense for overall readiness of the Naval Establishment.

Type Commander -- is responsible for the operational and material readiness of ships assigned to him by class, type or similarity of mission to the Fleet Commander. The Type Commander schedules and conducts operational training, maintenance, overhauls, supply overhauls (SOAP's) and sets policies and criteria for accomplishment of overall operational and material readiness of assigned ships. In addition the Type Commander is the source of funds for his ships to procure allowance list material (repair parts, consumables, equipage) in support of installed equipment. (An example of Type Commander is Commander Naval Air (Atlantic or Pacific), responsible for Carriers, aircraft assigned and other ships in support of the air mission.

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